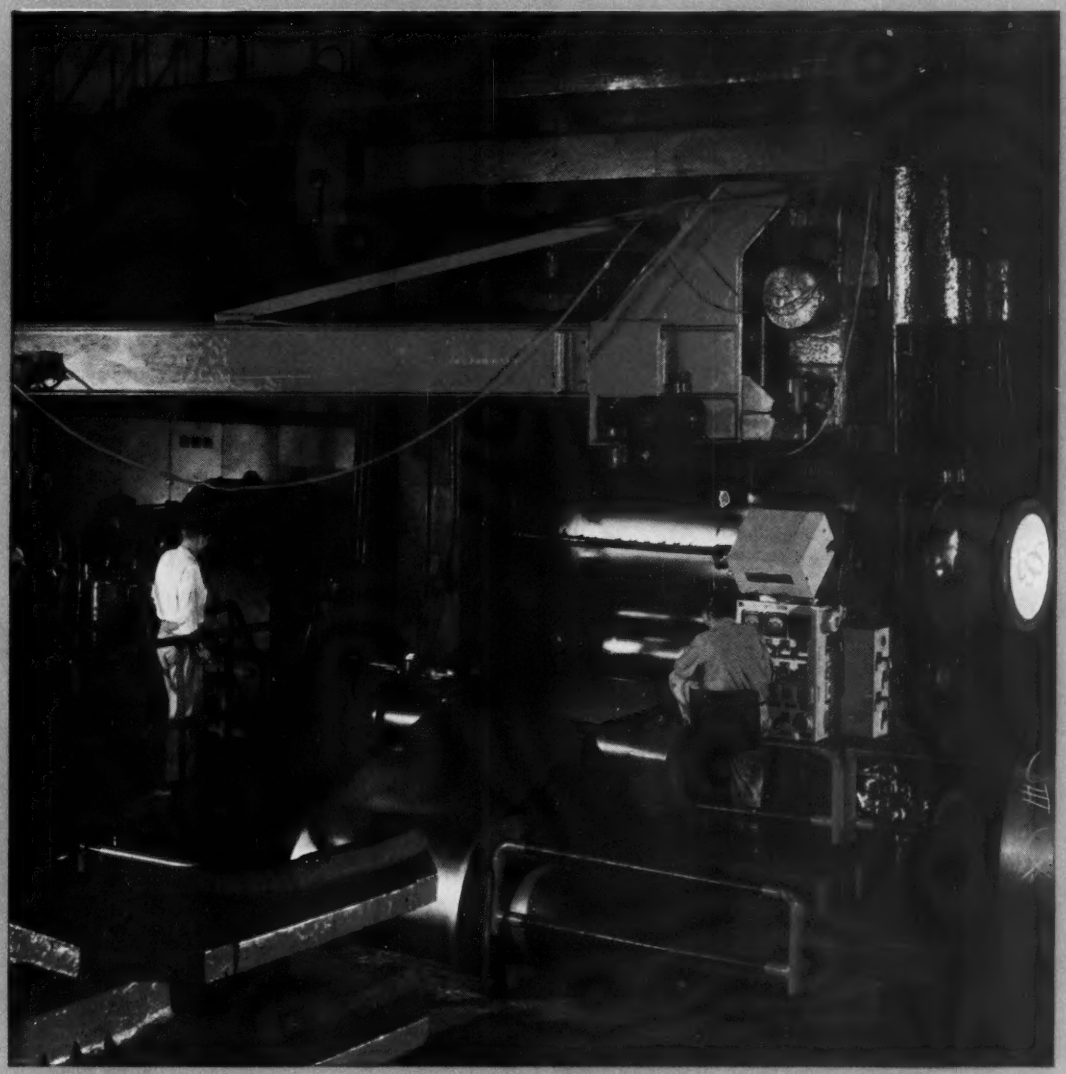
Vol. 16, No. 6 June, 1960

LUBRICATION ENGINEERING

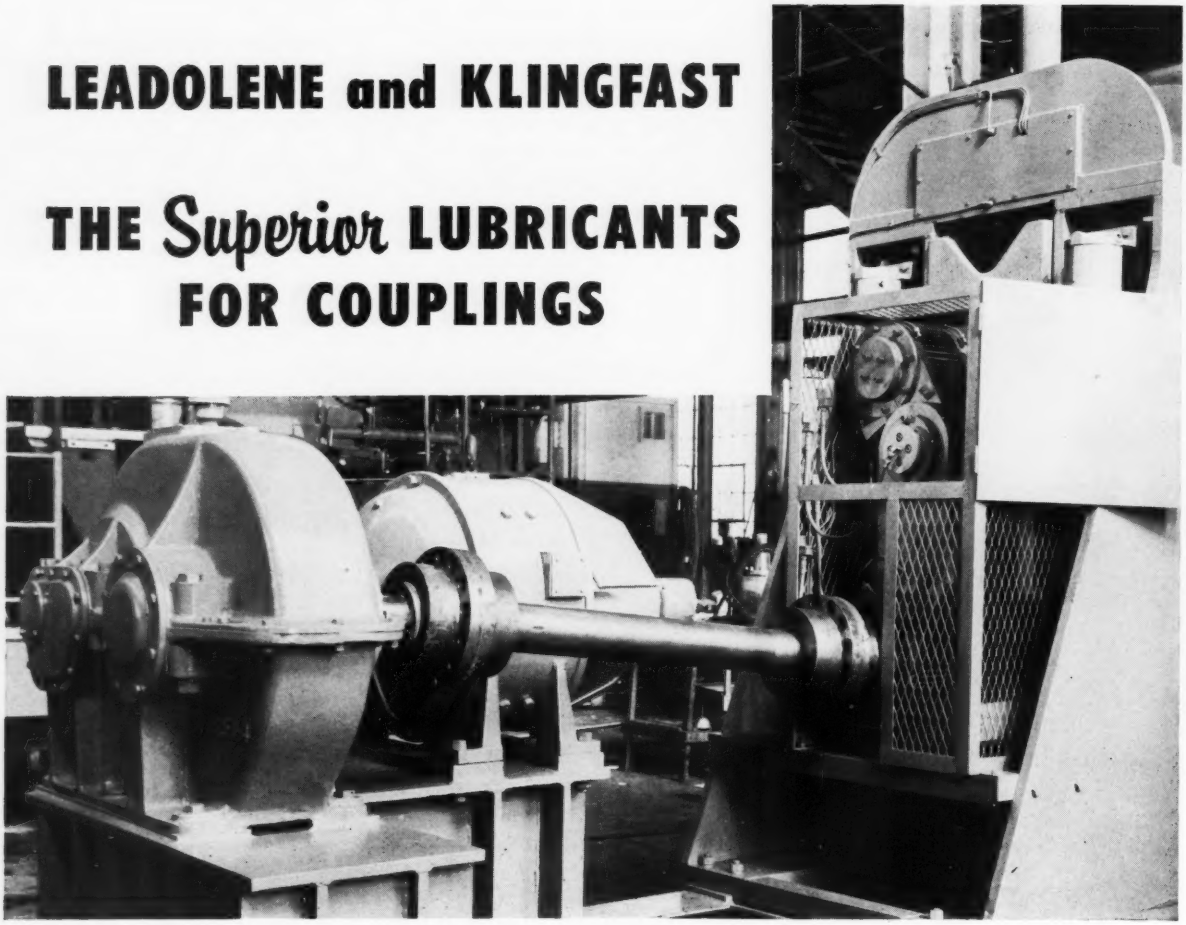
DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE



JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

LEADOLENE and KLINGFAST

THE *Superior* LUBRICANTS FOR COUPLINGS



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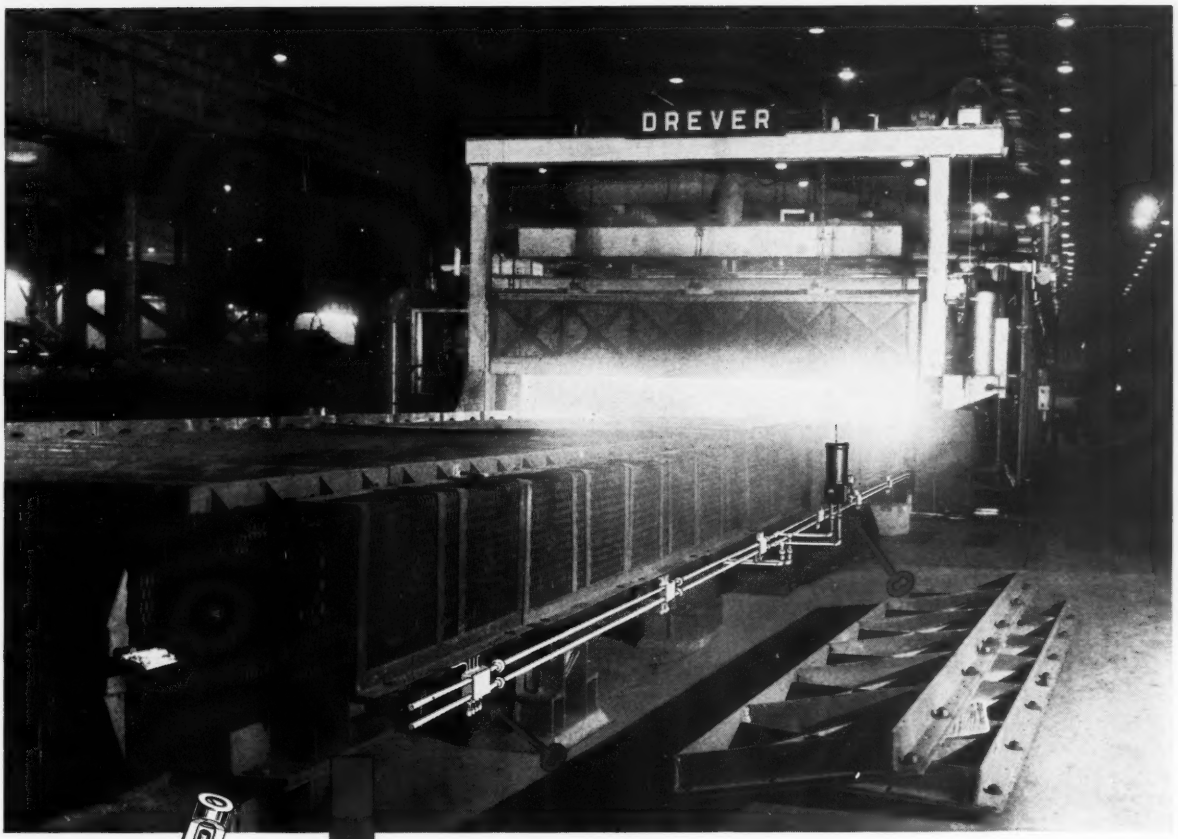

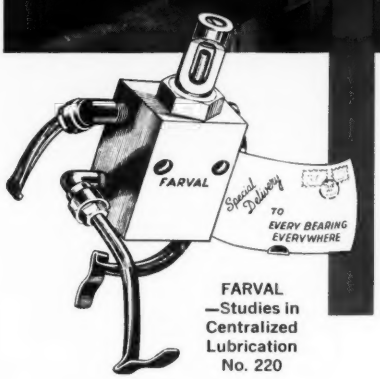

FARVAL
—Studies in
Centralized
Lubrication
No. 220

Farval system provides continuous, precision lubrication for huge heat-treat furnace

A MODERN Farval centralized lubrication system guards against premature bearing failure on both the approach and delivery tables of this huge, new 135-foot-long Drever continuous heat treating furnace now in operation at United States Steel's 160-inch plate mill. Its function is to harden armor plate, USS T-1 alloy and stainless steels—up to 45 feet long, 13 feet wide by 2 inches thick.

Farval's fool-proof Dualine system delivers just the right amount of clean lubricant to every bearing at regular intervals—from a safely located central station.

If you desire, we will have one of our specialists show how Farval centralized lubrication systems can save production hours, maintenance and labor in your own plant. Write today for revised Bulletin 26-T —it tells the complete Farval story.

Farval Division • Eaton Manufacturing Company
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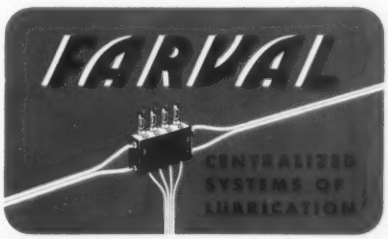
KEYS TO ADEQUATE LUBRICATION
—wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know industrial equipment, such as this heat-treat furnace entry table, is being properly lubricated.



For tin plate, light and intermediate gauge sheet, long terne and coating lines, Palmoshield is custom tailored to optimum mill speed and other requirements.

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SHIELD PRODUCTS

For all-domestic roll oils, address The Ironsides Company, Columbus 16, Ohio, compounders of Shield lubricants.

Volume 16, No. 6
June, 1960

Lubrication Engineering

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

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Cover photo courtesy United States Steel Corp.

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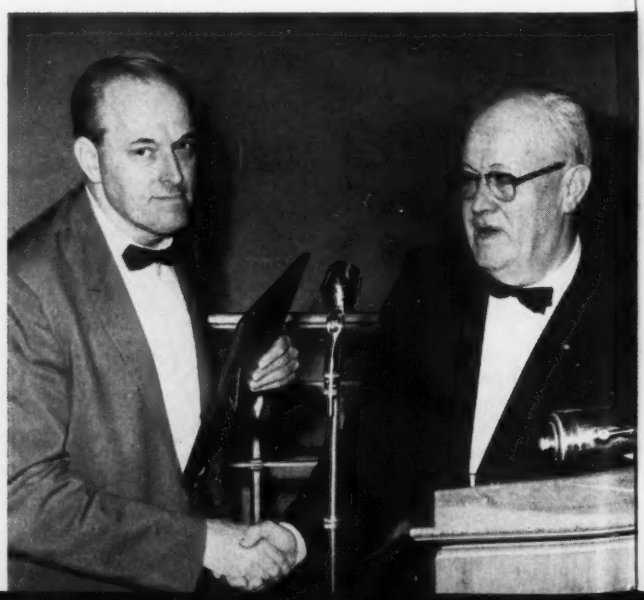
PHOTO HI-LITES FROM THE . . .

15th ANNUAL MEETING CINCINNATI, OHIO APRIL 18-21, 1960

Incoming President, L. O. Witzenburg, presides at Section Officers Meeting as J. D. Lykins (left), Past President, and A. B. Wilder, ASLE President, look on.

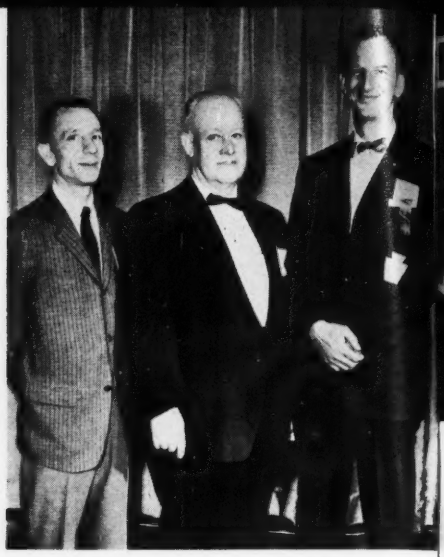
J. D. Lykins (right), Past President ASLE, presents Certificate of Appreciation to retiring President, A. B. Wilder.

A. B. Wilder presents a plaque denoting honorary membership to John Boyd, recipient of the ASLE National Award. Mr. Boyd's many important contributions in the field of hydrodynamic lubrication qualifies him to be named the outstanding man of the year in the field.



Left: M. E. Dougherty welcomes Ravindra Singh, an exchange student from India, to the ASLE Education Course. Under the able chairmanship of "Doc" Dougherty, all records for attendance at the Education Course were broken (see below). More than 130 students turned out to hear such outstanding lecturers as pictured to the right: Dr. M. E. Merchant (left), Director of Physical Research, The Cincinnati Milling Machine Co., and Fred Hanley, Research Engineer, California Research Corp.

The "old" Board under the chairmanship of A. B. Wilder winds up its business for the 1959-1960 year.



C. L. Willey, A. B. Wilder, and Rawdon Myers, Chairman of ASLE 1960 Annual Meeting Committee.

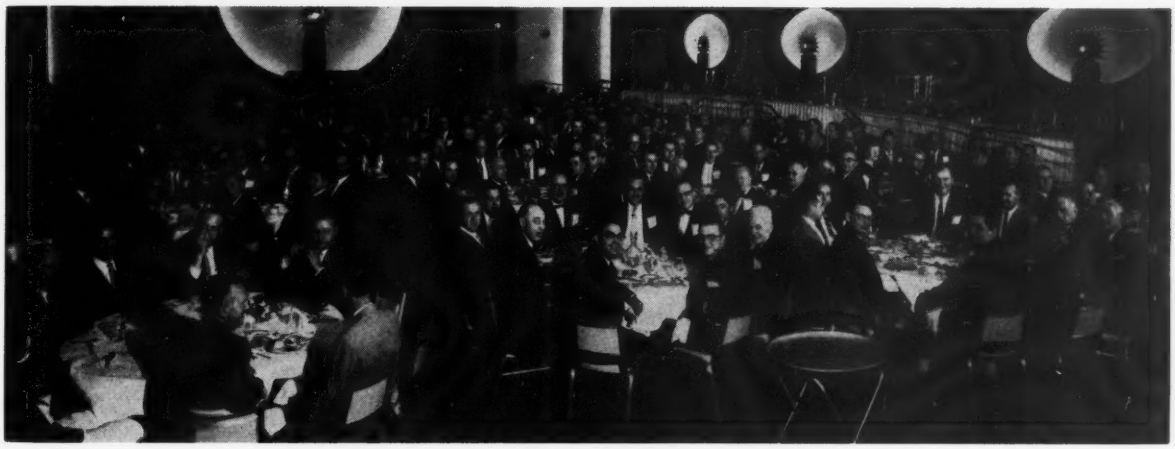
The ASLE Annual Banquet was a booming success as the crowd delighted to the entertainment of George Bailey and the Cincinnatians.

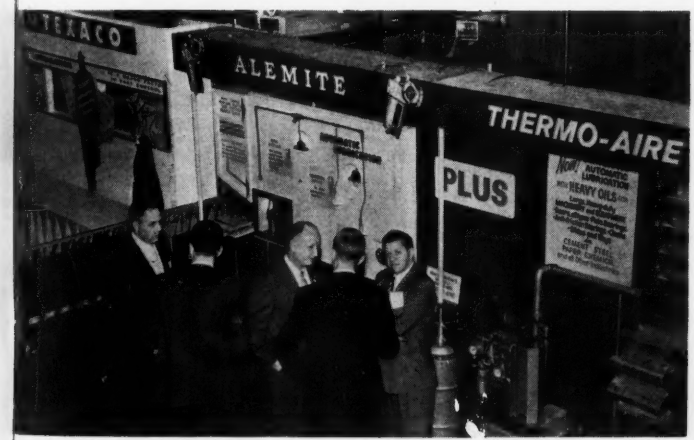
Technical Committees and Industry Lubrication Councils lay plans for program during the coming year.

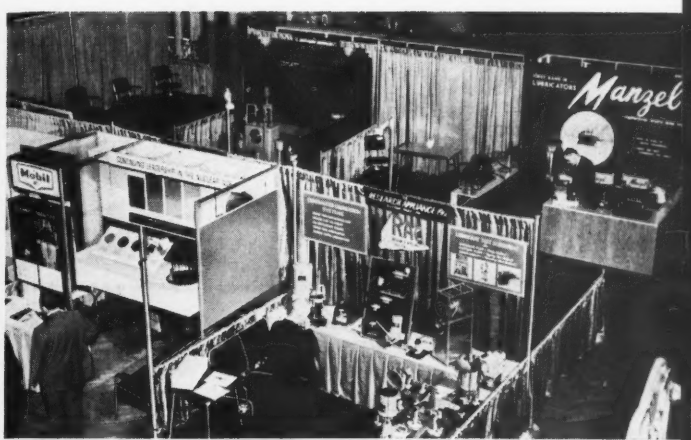
Traffic was brisk as more than 1200 visited the Exhibit Area.

Registration was handled efficiently under the direction of Helen Shinovich of the National Office.

All hands turned out for the ASLE Cocktail Party preceeding the Annual Banquet.







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AWARD RECIPIENTS

Each year at the Annual Meeting, awards are presented to deserving members of ASLE. This year, as every year, much time and thought went into the choice of people to receive these special awards. Those considered had to have given exceptionally of themselves and their knowledge in order to further the understanding of all those in the field of lubrication. These men have contributed greatly to the Society, the profession and themselves.

E. O. Forster and J. J. Kolfenbach, both of Esso Research and Engineering Co., received the Captain Alfred E. Hunt Memorial Award for their paper, "Viscoelastic Behavior of Greases," chosen as the best ASLE paper presented during the year.

Marco Petronio, Frankfort Arsenal, received the Wilbur Deutsch Memorial Award for his paper, "Lubricants in the Forming of Aluminum," chosen as the best paper on the practical aspects of lubrication.

The Walter D. Hodson Award for the best paper written by an ASLE junior author was awarded to Edward P. Kingsbury, ... , for his paper entitled, "Heat of Absorption".

ASLE
ASME

7th Annual Joint Lubrication Conference

OCTOBER 17, 18, 19, 1960
IN BOSTON
AT STATLER-HILTON HOTEL

Sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, in cooperation with the Boston Sections of both Societies.

This conference is aimed primarily at those concerned with Research and Development in the fields of bearings, gears, seals, and the lubrication thereof. It has become a leading source of information for those actively working in these fields, and for others who need to know what is happening at the forefront of the art and science of lubrication.

Papers are now being considered include: several on components, designs, materials for, and operation at, extreme temperatures, from lubrication with cryogenic fluids to bearings for 1200° F or higher. Interest and activity in gas bearing development is evidenced by an especially large number of submitted papers. Fundamentals of friction and wear receive their due attention.

Final details of the program will be available in July.

LUBRICATION IN THE NEWS

The Society will not be responsible for the accuracy of statements made in this column. Any reference to proprietary products does not imply an endorsement of such products by the Society.

FRED E. STOCKWELL ELECTED ASLE LIFE MEMBER

The board of directors recently elected Fred E. Stockwell of New Haven, Conn. as the second life member of ASLE. Mr. Stockwell, an ASLE member of more than 13 years standing, retired on October 1, 1954 after 24 years of service with Esso Standard Oil Company as a lubrication engineer.

HERTZ SCHOLARSHIP FOUNDATION EXPANDS COVERAGE

The Board of Directors of the Hertz Engineering Scholarship Foundation has announced that future scholarship activities, beginning with 1961 grants, will be expanded to include all fields of engineering.

Previously the Foundation only granted scholarships in electrical and mechanical engineering. Graduates of these two fields currently account for about half of all engineering bachelor degrees awarded annually.

"The Foundation has received a considerable number of applications in other engineering fields, particularly chemical, industrial and nuclear engineering, but up to now has been unable to consider these areas of study," said Russell Clevenger, Foundation Administrator.

Mr. Clevenger also said that in broadening the program the Foundation felt that, while the United States is in a favorable position with regard to the supply of so-called "abstract" or "pure" scientist, it is in need of applied scientist or engineers who can translate the pure scientist's ideas into practical applications. He also cited a recent survey by the Engineering Manpower Commission which estimated our nation's need to be 50% more engineers by 1966. (Source: Hertz Scholarship Foundation)

EFFECTS OF RADIATION STUDIED BY AIR FORCE

The effects of radiation on aircraft lubricants are evaluated in an Air Force report released to science and industry recently. The report summarizes results of tests conducted to evaluate fuels, lubricants, and hydraulic fluids for use in nuclear-powered aircraft. Fuel performance under normal conditions and in a radiation environment was measured with a fuel coker.

The study included tests of 52 fuels, 44 lubricating oils, 4 greases, 4 dry film lubricants, and a hydraulic fluid. Statistical tables show comparative performance characteristics of the most efficient fuels and lubricants tested. It is reported that pure chemical fuels out performed all other types, and all fuels listed in the tables gave a satisfactory performance. Greases were tested for high temperature performance in antifriction bearings, and dry film lubricants were tested in a Hartmen-Modified MacMillan Tester. In both cases, the report shows that there was no significant difference in performance between normal and radiation environments.

The report, *The Behavior of Fuels and Lubricants in Dynamic Test Equipment Operating in the Presence of Gamma Radiation: Part 2*, may be had by ordering PB 161127 from OTS, U. S. Department of Commerce, Washington 25, D. C., price, $3.00. (Source: U. S. Department of Commerce)

SKF NAVY HANDBOOK SETS U.S. STANDARDS FOR DEFENSE PRODUCTS

The two-volume Rolling Bearings Standardization Handbook prepared by SKF Industries, Inc. under a Navy contract for the Department of Defense standardization program incorporates the latest industry-wide information covering bearing load capacities, performance, and maintenance techniques. It marks a significant step in standardizing American industrial products for the Armed Forces.

In addition to establishing standards of comparative performance for bearing manufacturers' products, the SKF handbook will permit the military to specify bearings in all future contracts using a universally accepted rating system. It will be useful to service technicians, government civilian specialists, and government contractors responsible for designing or maintaining rolling bearings in U. S. military equipment. (Source: SKF Industries, Inc.)

LUBRICATING GREASE PRODUCTION UP LAST YEAR

According to the National Lubricating Grease Institute, production of lubricating greases increased almost ten percent in the United States during 1959, over 1958 production, while fluid gear lubricant production also showed a gain last year.

The NLGI survey reportedly collects data on six soap types and on total fluid gear lubricant production; and because an estimated 95 percent of the industry belongs to the Institute, the 78 percent of manufacturers replying to the survey give what has been generally accepted as an 85 percent of actual lubricating grease production in the United States. (Source: National Lubricating Grease Institute)

IDENTIFICATION CODE FOR BALL AND ROLLER BEARINGS IS NEW AMERICAN STANDARD

To provide a universal language for describing and identifying bearings in order to facilitate communications between user and the manufacturer, American Standard Indentification Code for Ball and Roller Bearings, B54.1–1960 has been approved by ASA. The code also simplifies the handling by the user's personnel of identical bearings made by different manufacturers whose various identification numbers may be difficult to interpret. Seventeen government agencies, technical societies, and trade associations developed the new standard which was sponsored by the Anti-Friction Bearing Manufacturers Association. The new American Standard agrees in all major technical respects with a proposed international identification code for bearings. (Source: American Standards Assoc.)

AMERICAN STANDARDS THERMOCOUPLE PROJECT RECOMMENDED

The establishment of an American Standards project on thermocouples was recommended by representatives of 16 national trade associations, technical societies, and industry at a recent General Conference. Thermocouples are employed wherever temperature must be measured. The purpose is to simplify the use and aid in the manufacture of thermocouples and thermocouple extension wires which are used extensively throughout industry. The Instrument Society of America will be invited to serve as sponsor for the project. (Source: American Standards Association) (*Continued on page 251*)

INDUSTRY NOTES

A major expansion of its operations as it moved into new facilities was announced by Viscosity Oil Company. With over 500,000 gallons of storage capacity, Viscosity has devised an individual piping system for all its 56 tanks and kettles to prevent contamination, assuring fast and reliable service.

The company's technical skill and modern laboratory for product control, product application, research and development combine to produce industrial and automotive greases and lubricants and additives to lubricate all types of equipment.

The firm's new location is 3200 South Western Ave., Chicago 8, Illinois.

To handle its increasing West Coast business, E. F. Houghton and Co. has opened a new plant at 54 Tanforan Ave, South San Francisco. Industrial oils and chemicals formerly manufactured at Houghton's plant in San Francisco are now being supplied by the new facility.

The new plant is located on a three-acre plot and includes 30,000 square feet of manufacturing space, a new office building, control laboratory and 10,000 square feet of outdoor storage area. Capacity has been increased more than 50% over the former plant.

Metalworking items and functional fluids such as cutting and quenching oils, rust preventives, metal cleaners, specialty lubricants, hydraulic fluids and packings are included in the product line, these being supplied from five other plants over the country.

The Enjay Company, Inc., petrochemicals firm, recently became the Enjay Chemical Company, a division of Humble Oil and Refining Co. The company's headquarters are in New York, with offices in Akron, Boston, Charlotte, Chicago, Detroit, New Orleans, and Tulsa.

According to Morgan J. Davis, president of Humble, Enjay Chemical Company will be directly responsible for both the marketing and coordination of the Humble Company's chemical products activities throughout the United States. In addition, Enjay will sell chemicals to Esso Export Corp. for distribution in foreign markets.

J. E. Wood, III, former president of Enjay Co., Inc., has been appointed president of Enjay Chemical Co. Others named to serve as officers of the newly-created division are: A. D. Green, R. K. Dix, and K. J. Nelson, vice presidents; A. F. Imlay, treasurer; T. C. Lewis, assistant treasurer; F. P. Hagaman, controller; and N. M. Fillastre, assistant controller.

Walworth Company, valve and fitting manufacturer, has recently reorganized its Sales Department to give new emphasis to the marketing of valves. In the move, the company has regrouped virtually the entire General Office Sales unit directed by Harold Brown, vice president, sales. In announcing the reorganization, Walworth explained that the new structure was adopted to allow the company to stress the scientific selling of valves, utilizing its sales techniques such as seminars and unusual direct mail campaigns.

(*Continued on page 292*)

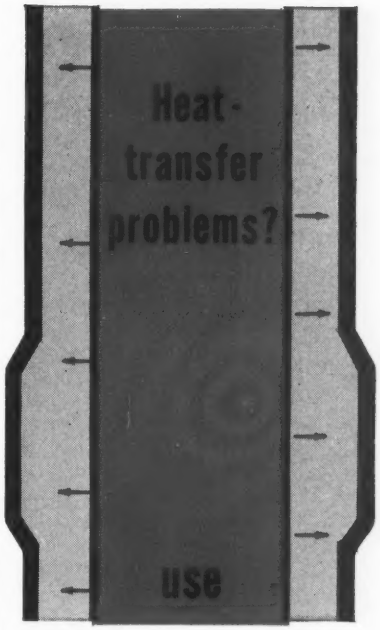
LUBRICATION IN THE NEWS

(*Continued from page 250*)

NOEBELS TO BE DELEGATE AT AUTOMATIC CONTROL CONVENTION IN MOSCOW

Henry J. Noebels, Manager of Application Engineering, Scientific and Process Instruments Division, Beckman Instruments, Inc., will be a U. S. delegate to the first worldwide convention of the International Federation of Automatic Control to be held in Moscow, Russia, from June 27 to July 6, 1960. The Federation was formed in Paris, France, in 1957, with the objective of promoting the science of automatic controls among nations. More than 1500 people are expected to attend the international conference in Moscow. The five societies comprising the American Automatic Control Council represent the United States in the Federation.

While in Russia, Noebels will speak on theoretical considerations in the use of chromatography for process control. Noebels will deliver a series of lectures on the subject of instrumentation in Germany, Italy, and France, prior to the Moscow meeting. (*Source: Beckman Scientific and Process Instruments Division*).



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SECTION NEWS

Montreal—The subject of "Two Cycle Engine Lubrication" was presented at the May meeting by D. C. Brady, Lubrizol Corp., Cleveland, Ohio. . . . **Toronto**—Over 40 people were in attendance at the April meeting. A report on the Lubrication Course sponsored by the section this spring showed that 102 people attended the course, 7 new members, and a net profit of $871.00. The guest speaker of the evening was Earl Sillett, Canadian Westinghouse Company, Limited, who spoke on "Grease Worker Results and Their Significance in Antifriction Bearing Application." . . . **Connecticut**—In an effort to simulate an interest in the field of lubrication, the Connecticut Section has offered to provide financial aid to a deserving engineering student. It was decided to allocate $200.00 to the University of Connecticut for this purpose. The Scholarship Fund is to be known as the "American Society of Lubrication Engineers Scholarship Fund," the recipient to be a deserving upper classman of the engineering school and a resident of Connecticut who has shown an aptitude for and a desire to study engineering. It was further provided that after all conditions are met that deserving sons of ASLE members be given ample opportunity to qualify. The Connecticut Section does not require repayment of the fund, however, it is felt that one recipient will make repayment when financially able so that others may benefit. In accepting the proposed conditions of the award, Dr. A. N. Jorgensen, President, University of Connecticut stated, "We are delighted to learn of your group's interest in providing a financial aid to a deserving engineering student . . . the proposed conditions . . . have been reviewed. . . . We wish to express our willingness to comply with the conditions and to expedite the establishment of the scholarship fund under the name of the American Society of Lubrication Engineers Scholarship Fund. . . . Sincerely yours, A. N. Jorgensen, President." A. W. Ackerman, Anderson Oil and Chemical Co., has been selected to receive the first Certificate of Award from the Eastern Region Sections of ASLE for his paper, "Cutting Fluids as Engineering Methods." He was chosen as the author of the best original paper presented before one of the Eastern Region Sectional meetings. . . . **Chicago**—In addition to being election night, the April meeting featured an educational session when Anthony S. Zummer, Attorney at Law, spoke on "Don't Slip on an Invention." Technicalities of inventions and patents were explained and the talk evoked a lively question and answer period. . . . **Boston**—Following an afternoon tour of the Western Electric Company in North Andover, Mass. on April 11, members heard a talk on "Quartz Cutting and Crystal Development" by L. V. Stonebraker, Western Electric Co. The evening meeting included a film entitled, "You and the Silicones," presented by R. E. Bright, Dow Corning Corp. Following the film, Mr. Bright presented a "Review of Silicone Lubricants." . . . **Los Angeles**—Veyne Mason, Independent Research, is serving as General Chairman of a 3-day Symposium to be held in February 1961 by the University of California. A series of papers and discussions will be presented on the subject, "Fluid Filtrations—Contaminant Behavior and Control." . . . **Twin City**—A joint SAE and ASLE Section Spring Party and Dinner Dance was held on April 29. . . . **Duluth-Iron Range**—The subject of "Hydraulic Oils and Fire Resistant Fluids" was presented at the April meeting by Harry W. McColloch, Jr., Shell Oil Co. . . . **Hudson-Mohawk**—"Diffusion Coatings" was presented at the April meeting by Dr. John W. Grenier, Chemist in the Materials and Processes Laboratory of the Schenectady General Electric Company. His discussion dealt chiefly with siliciding and boriding processes. . . . **Syracuse**—A talk, "General Tumbling Operations," by Joe Kessler, Van Straaten Chemical Co., covered the use of tumbling compounds for polishing and burnishing metals. . . . **Intermountain**—At the March dinner meeting, ASLE's Western Regional Vice-President, Dudley P. Thomas, presented a paper and slides on the subject: "Bulk Grease Handling." A meeting of the executive committee was held on March 28. The discussion covered the duties of each executive committee member; increasing the membership of the local section; and the possibility of national recognition of the section through the development of local speakers and also trying to secure papers from local men for publishing in LUBRICATION ENGINEERING. . . . **Rochester**—Management Night was observed at the regular monthly meeting on May 11. Management and their representatives were invited to attend the meeting to learn the facts about a lubrication program in

(Continued on page 292)

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LUBRICATING GREASES
METAL WORKING LUBRICANTS
SPECIAL PROCESS OILS

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Consult Our Lubrication Engineers

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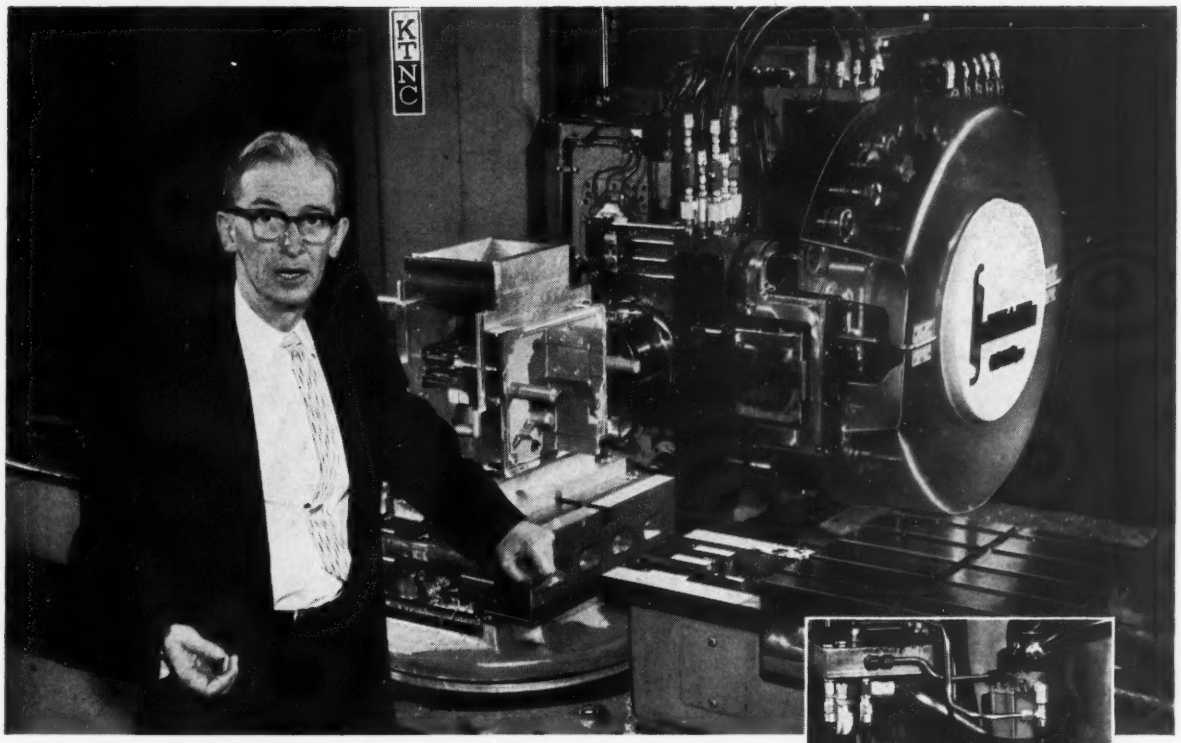
Franklin Park, Illinois Chicago Phone TUxedo 9-4800



Mr. Julian Kerlin, Field Service Engineer for Kearney-Trecker Service Division, explains the contribution of Micro-Fog Lubrication to MILWAUKEE-MATIC reliability and ease of servicing.

Norgren Micro-Fog® Lubrication gives Kearney & Trecker greater flexibility in machine design

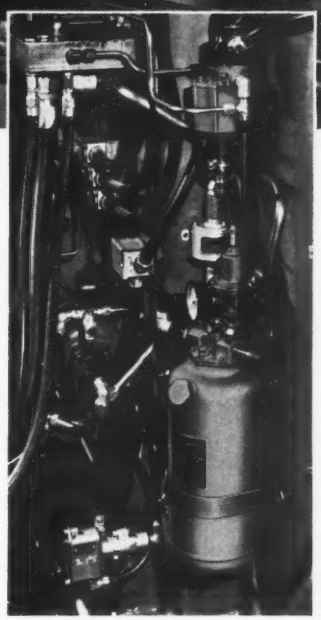
The new Kearney & Trecker tape-controlled MILWAUKEE-MATIC is an outstanding example of flexibility in modern machine design. In a single machine, the MILWAUKEE-MATIC performs all the operations of milling, drilling, reaming, tapping and boring that usually require several machines.

The Milwaukee-Matic is designed for maximum "chip time" and minimum set up and down time. This requires high reliability of operation and provision for rapid servicing.

This is why Kearney & Trecker engineers chose **Norgren** Micro-Fog for the lubrication system.

The Micro-Fog centralized air-borne lubrication system gives constant, reliable, metered lubrication at each bearing point. Alarm devices are connected to the control system of the machine to give warning of conditions affecting proper lubrication.

Micro-Fog is conducted to all bearing points through tubing, eliminating the need for cumbersome and costly return piping, oil filters, sumps and pumps. The result, as Kearney & Trecker found, is a wider latitude in machine design. With **Norgren** Micro-Fog, they were able to make maximum use of unitized construction in the MILWAUKEE-MATIC, providing for fast disassembly and component replacement.



This Norgren Micro-fog Lubro-Control Unit provides lubrication for the bearings on Kearney-Trecker's MILWAUKEE-MATIC, and for the slides, ways, gears and clutches in the head.

If you design machine tools which require measured, reliable lubrication of bearings, gears, slides, chains or ways, and want greater design flexibility, it will pay you to investigate Norgren Micro-Fog Lubrication. Write for detailed information, or call your nearby Norgren Representative listed in your telephone directory.

FOUNDED IN 1926

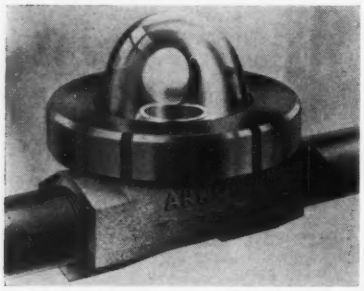
C.A. NORGREN CO.

3434 SOUTH ELATI STREET
ENGLEWOOD COLORADO

NEW PRODUCTS

NEW "BALL TYPE" INDICATOR FOR VERY LOW FLOWS

For flows down to 0.075 g.p.m. (water) and ½ c.f.m. (air or gas), a new "Ball Type" Flow Indicator has been announced by McIntosh Equipment Corp. The flow makes the ball dance in a toughened glass dome. If the flow stops, the ball drops out of sight.



The indicator is useful in applications such as air, steam, water, and oil purge lines to instruments and mechanical seals; cooling water to compressors, condensers, jacketed process vessels, laboratory equipment, and electronic equipment; lubricating oil to bearings.

The new Akron "Ball Type" Flow Indicator is made in ½" pipe size for pressures up to 100 p.s.i. with die-cast bronze body, and either Nylon or Teflon ball. It is available from McIntosh Equipment Corp.,-Walker, Crosweller Div., 15 Park Row, New York 38, N. Y.

NEW PUMP AND MOTOR COMBINATION INTRODUCED

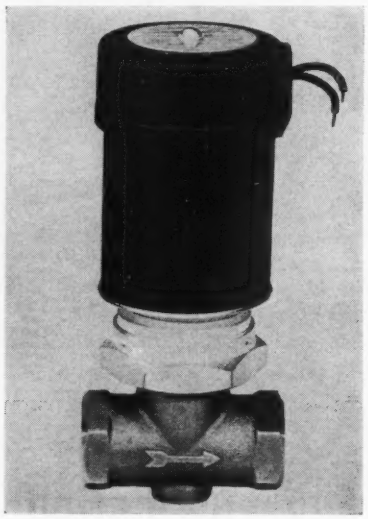
The Tuthill Pump Company of Chicago has announced the addition of a new series 56 pump and motor combination to its line. The new unit is designed for use in hydraulic, lubrication, oil burning, fuel transfer, and other services.

The new series has overall dimensions of 6 11/16" × 11 23/32". The combination includes motors in the NEMA 56 series ranging from ¼ to 1 hp in either single or three phase. These may be combined with a selection of five different pumps with capacities from 20 to 360 gph, at 200 psi.

For more information about the new series 56 pump and motor combinations, write the Tuthill Pump Company, 939 East 95th Street, Chicago.

NEW ATKOMATIC SOLENOID VALVES AVAILABLE

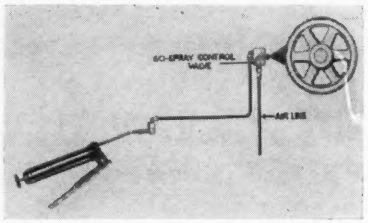
Atkomatic Valve Company announces the availability of a '1500' Series Solenoid Valves, featuring direct lift action full-ported construction to insure reliable operation regardless of pressure drop of flow conditions.



These valves, designed for pressures from 0 to 1500 psi and for temperatures from −35° to +450°F, are reported to be bubble-tight, leakproof, and packless. They are available in bronze or stainless steel in ¼" to 1" pipe sizes.

For a copy of Bulletin S-2, which gives full specifications and prices, write Atkomatic Valve Company, 545 West Abbott Street, Indianapolis, Indiana.

A NEW SPRAY LUBRICATING SYSTEM ANNOUNCED



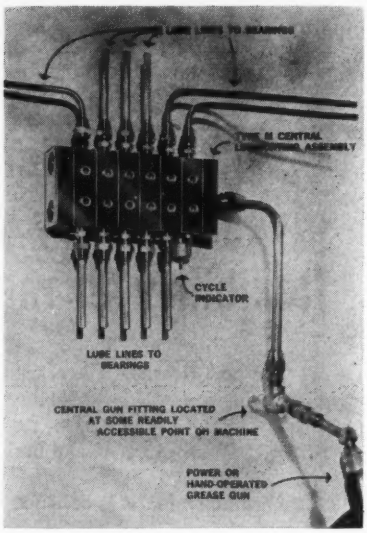
At the 1960 American Society of Lubrication Engineers Annual Meeting and Exhibit, held in Cincinnati, Farval Division, Eaton Manufacturing Company, announced a spray lubricating system for industrial gearing where inaccessability presents a danger to maintenance personnel.

With a hand grease gun attached to a conveniently located fitting, lubricant will be sprayed as long as pumping is continued. Lubricant pressure forces down a spring-loaded piston, opening porting to the Farval spray control valve, allowing air and lubricant, each under its separate pressure, to be forced through the spray nozzle. When lubricant flow ceases, the piston returns to its original position, closing the ports. The air supply is then shut off, limiting compressed air consumption to the amount needed for each delivery of oil or grease.

For more information, write: Farval Division, Eaton Manufacturing Company, 3300 East 80th St., Cleveland 4, Ohio.

CENTRALIZED GREASE SYSTEM FOR LUBRICATING SMALL MACHINES ANNOUNCED

A new compact gun-operated system for centralized lubrication of small machinery, or where space does not permit mounting a manual or automatic pump, has been announced by Trabon Engineering Corp.


CYCLE INDICATOR
LUBE LINES TO BEARINGS
CENTRAL GUN FITTING LOCATED AT SOME READILY ACCESSIBLE POINT ON MACHINE
POWER OR HAND-OPERATED GREASE GUN

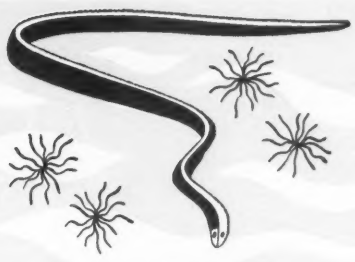
Up to 16 outlets may be handled from a single Type M assembly with outputs varying from .010 to .070 cubic inches of grease per cycle. A cycle indicator, located on the side of the assembly, enables the grease-gun operator to cycle the assembly the correct number of times to give each bearing its exact amount of lubricant. The system is designed for the measuring pistons to operate in sequence, so that every bearing gets a full shot and any blocked line or bearing stops the cycle, "freezing" the indicator pin.

More information is available from Trabon Engineering Corp., 28815 Aurora Rd., Solon, Ohio.

(*Continued on page 256*)

IF YOU ARE LOOKING FOR...

HIGH ADHESION



GOOD LUBRICITY

EXCELLENT WETTABILITY

CONSISTENT QUALITY

INVESTIGATE CSC's NEW SYNTHETIC WAXES

NOW COMMERCIALLY AVAILABLE

TX-1 and TS-254 have made the grade from laboratory to plant production. They are oxazoline waxes—an entirely new product series from CSC's Nitroparaffins. Since they are synthetic, availability and consistency of quality present no problems.

TX-1 is a hard, high-melting emulsifiable resin-like wax, light brown in color, translucent in appearance.

TS-254 is a hard, medium-melting, cream-colored wax.

ATTENTION AEROSOL FORMULATORS: These waxes form true solutions in many organic liquids thus greatly simplifying aerosol formulation problems. No settling in the can! No clumps to block the orifice!

The oxazoline structure is unique among waxes, both natural and synthetic. From it comes *high adhesion, good wetting on hard surfaces* and *good lubricity. These waxes are compatible with most natural and synthetic waxes.* Stable gels or pastes are formed when they are dissolved in high concentrations in many organic liquids.

Because of these properties, TX-1 and TS-254 are expected to be useful in self-polishing floor waxes, paste polishes, leather, paper, and textile finishes, synthetic lubricants, metalworking lubricants, cosmetics, as mar-proofing agents in enamels, and as pigment grinding assistants.

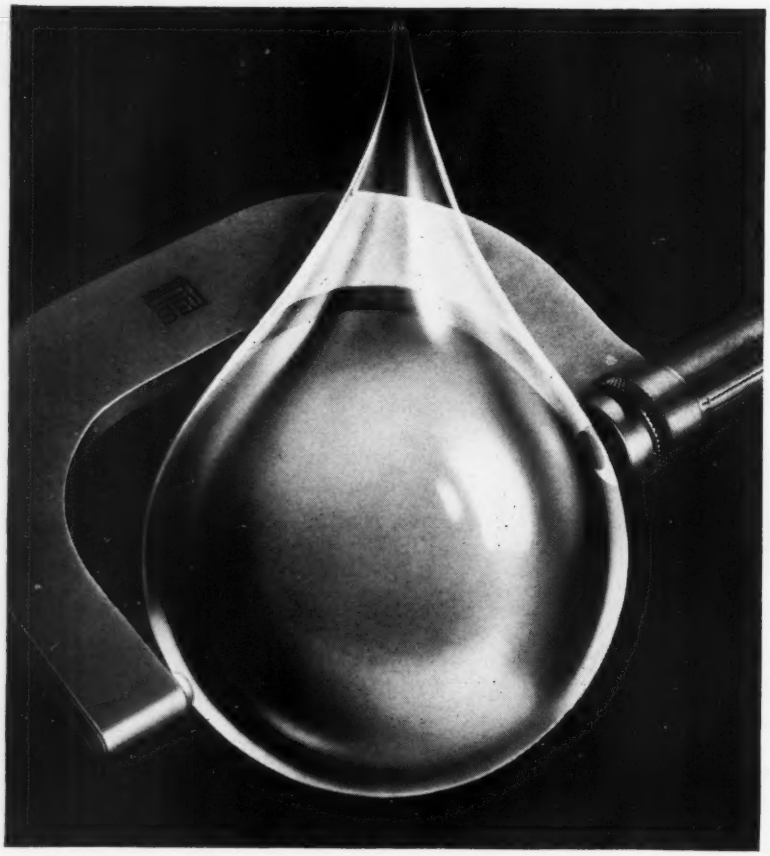
There are four other oxazoline waxes also available. Let us discuss your specific problem and provide you with samples. Write on your letterhead to Market Development Department, Commercial Solvents Corporation, 260 Madison Avenue, New York 16, New York.

PHYSICAL PROPERTIES	TS-254	TX-1	ES-254	TS-254A	TS-254AA	TS-970
Melting point °C	63	160	37	50	93	74
Volume Expansion on melting—%	7.7	—	8.9	9.2	9.2	9.1
Penetration, ms/100 gm. load (ASTM D5-25)	0.2	—	1.3	0.3	0.4	0.1
Acid No. (approx.)	7	12	9	2	1-2	6
Solubility, % by wt. in:						
Butanol	7	49	50	22	13	4
Toluene	16	52	49	16	7	16
Carbon Tetrachloride	16	47	49	gel	14	gel
Stoddard Solvent	12	52	49	17	4	5
Butyl Acetate	11	55	49	13	9	6
Methyl Isobutyl Ketone	10	ins.	49	10	8	5
Turpentine	21	10	24	21	10	10

COMMERCIAL SOLVENTS CORPORATION

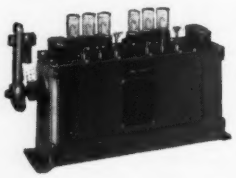
CSC

How ACCURATE



can an oil drop get?

Precise and punctual is the best way to describe an oil drop metered by a Manzel force-feed lubricator. Model "82", for example, will deliver an exact amount of oil exactly where it belongs at exactly the right point in the cycle of your mechanism. The positive sight feed shows you the oil on its way to work *after* it's passed through the pump. Our Model "82" is built for pressures up to 6000 PSI and "round the clock service"! For details on "82" or any of our complete line of lubricators, write for our catalog. Manzel, 254 Babcock Street, Buffalo 10, New York. To lubricate with mathematical precision, just



ask the man from

A UNIT OF HOUDAILLE INDUSTRIES, INC.

Manzel

SPECIALISTS IN LUBRICATORS AND METERING PUMPS SINCE 1898

NEW PRODUCTS

(Continued from page 254)

NEW OIL LEVEL GAUGE OFFERED

A new oil level gauge has been announced by the Sure Gauge and Lock Company of Dayton, Ohio. According to the company officials, the gauge shows the exact amount of oil present in the crankcase, notifying the operator of the equipment when extra oil is needed.

The new oil level gauge consists of a cork level which is contained within a tubular steel casing. The casing is mounted directly to the side of the crankcase. A small hole is bored in the crankcase to permit oil to flow into the casing and actuate the cork float. Since the oil will seek its own level, the cork will rise or fall to the exact level of oil in the crankcase.

The level of the oil is registered on a meter which is calibrated in quarters. The meter is wired to the ignition and the cork level. When the ignition is turned on, the needle on the meter records the level of oil just as a gas gauge records the amount of fuel in the tank.

Sure Gauge & Lock Company is fully guaranteeing its new oil level gauge for one year. Standard trade discounts are given to dealers and distributors and discounts are also being given to users who buy the gauge in quantity. List price is $19.95. Inquiries should be directed to the Sure Gauge & Lock Company, Division of Waterworth Engineering, 2329 Troy St., Dayton, Ohio.

TUBE-COOLED MOTORS AVAILABLE

The Louis Allis Co., Milwaukee, has announced the introduction of Tube-Cooled air-to-air heat exchanger motors.

These motors, ranging up to 2000 HP, are built in standard enclosed construction for use in non-hazardous locations and in explosion-proof construction with Underwriters Laboratories Class 1, Group D Label for use in hazardous locations.

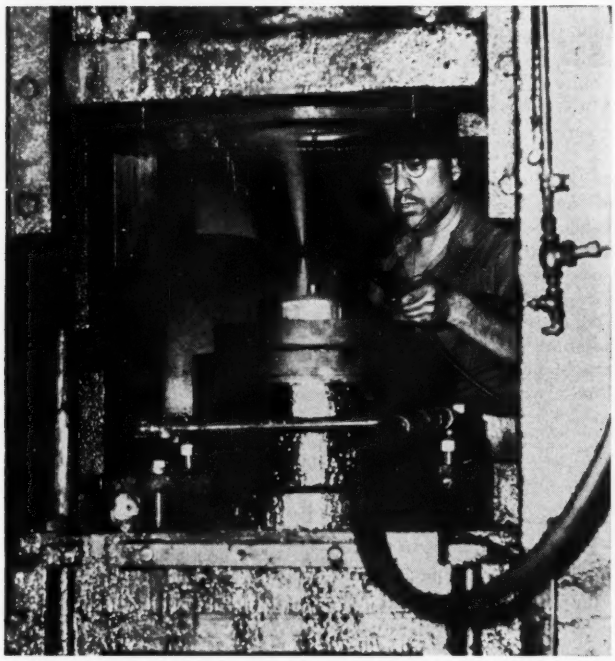
Tube-Cooled motors are designed to operate in unfavorable environmental conditions, providing protection against excessive moisture, oil vapor, chemicals, alkalies, coolant and air-borne dust, sand, dirt, and metallic particles. They have application in industries such as petroleum, chemical, mining and primary metal processing, machine tool and pulp and paper. They are used on pumps, compressors, fans and blowers, mixers, mills, crushers, conveyors, presses, special industrial machinery and refiners, etc.

Other reported features include an effective cooling system, corrosion resistant construction, capsule type split sleeve bearings and pressure lubricating systems with oil level indicators.

For complete information write for Bulletin #2400, The Louis Allis Co., Dept. P, Milwaukee 1, Wisconsin.

FORGING OR TAPPING . . . 'dag' DISPERSIONS BRING IMPRESSIVE SAVINGS

The versatility of Acheson 'dag' brand dispersions has been proven in many metalworking applications. Here are two such examples: the one involving the material-time savings possible by the use of sprayable colloidal graphite; the other, overcoming pressure and frictional heat problems with the use of a mica dispersion by Acheson.



'Prodag' is automatically spray-applied simultaneously on both upper and lower die surfaces of this forging press at Mueller Brass.

Mueller Brass Company saves $15,000 a year in labor-material costs alone. This is in addition to increasing die life, reducing the scrap loss, and improving the finish of their forgings . . . the reasons why Mueller initially chose Acheson's Prodag® over other forging lubricants. The total savings can be estimated as "considerable", since this Port Huron, Michigan company is the world's largest producer of brass and bronze forgings.

Before using 'Prodag' — a dispersion of graphite and water, Mueller lubricated their crank forging presses with a highly viscous, petroleum-based material which had to be swabbed by hand between each press stroke. The human element frequently meant too much lubricant being applied in some areas of the die, too little in others. The result in the first case, was either imperfect forgings or cracked dies brought about through displacement pressures. In die areas where there was insufficient lubrication, metal stuck in the die cavity. The forged piece had to be scrapped and time was lost while the metal was pried out of the die.

To overcome these multiple problems, Mueller was introduced to a sprayable lubricant and designed their own spray equipment, which lubricates lower and upper dies simultaneously. In this application, 'Prodag' is diluted 1 to 35 with water and is kept under agitation at the press. Time studies have shown that spraying has given them a five percent-per-pound economy over swabbing. Even more importantly, the use of 'Prodag' has resulted in more uniform, complete coverage. The $15,000 to $17,000 annual labor-material savings has, in Mueller's opinion, actually been a "bonus" over and above their original purpose of achieving better forgings and greater die life.

'dag' 242 improves hole tapping operation at General Steel Wares' Montreal Plant

Hole-tapping operations at General Steel Wares, Ltd., Montreal, Quebec, have improved with the application of 'dag' 242 — a dispersion of mica in petroleum oil. So much so, in fact, that an annual savings of approximately $8400 has been realized. The problem was this: broken spud threads during tapping operations on galvanized range boilers, caused a reject percentage of 27%. Fed to the tap as pictured below, the area of the boiler spud was subjected to high pressure and frictional heat. A proprietary type of water-soluble paste had previously been used.

Mr. E. R. Hails, Works Manager at General Steel Wares, found, after detailed investigation of all components involved in the operation, that the lubricant was the key to greater efficiency and fewer rejects. 'dag' 242 was recommended and put into use. Applied by brush to the tap and spuds, this material was immediately effective. The results speak for themselves; from an average life of 3000 spuds per tap, General Steel Wares now averages over 14,000 per tap with 'dag' 242.

Before threading range boiler holes, 'dag' 242 is applied by brush to the tap and spuds.

Perhaps you could be earning similar production economies by using one of the many fine Acheson Dispersions tailored for metalworking use. For further information write for your copy of Bulletin 426 — For Metalworking Applications. Address Dept. LE-60

'dag', 'Prodag' are trademarks registered in the U. S. Patent Office by Acheson Industries, Inc.

ACHESON

dispersions digest reporting uses for

dag® BRAND DISPERSIONS

ACHESON *Colloids Company* **PORT HURON, MICHIGAN**

A division of Acheson Industries, Inc. Also Acheson Industries (Europe) Ltd. and affiliates, London, England

Offices in:

Boston • Chicago • Cleveland • Dayton • Detroit • Los Angeles • New York • Philadelphia • Pittsburgh • Rochester • St. Louis

PRODUCT LITERATURE

GEAR BROCHURE AVAILABLE

A new 4-page brochure published by Ohio Gear Company shows and describes a complete line of stock and special gears designed to meet all industrial power drive requirements. Both 14½° and 20° pressure angle styles are included.

The free literature contains information on bevel, helical, miter, worm and spur gears as well as steel racks. It stresses the ready availability of these stock gears from local supply areas in 52 major cities throughout the United States and Canada.

The booklet is available from Ohio Gear Company at 1200 East 179th Street, Cleveland 10, Ohio.

FOLDER OFFERED ON NEW OPEN CHAIN LUBRICANT

A new four-page folder explaining why a new special lubricant makes open chains last up to 3 times longer is available from The Whitmore Mfg. Co., Cleveland 4, Ohio.

The new lubricant packaged in a 16 oz. push-button aerosol container was formulated especially for use on open chains and combines the features of a penetrant, a lubricant, and a rust-preventative to reportedly lengthen open chain life up to 300%.

Whitmore's new descriptive folder illustrates many types of conveyor, transmission, and elevating chains and indicates the critical points that benefit from specialized open chain lubrication. A copy of the new literature is available for the asking from The Whitmore Mfg. Co., Cleveland 4, Ohio.

FLUID FILTER BULLETIN AVAILABLE

A new bulletin designed to help aircraft and missile engineers select the correct fluid filter for specific applications has been published by the Air-Maze Corporation of Cleveland.

The free literature emphasizes the complete flexibility now available in filter determination by combining housing types with various elements and filter media. The aircraft filters may be used for gas, air, fuel, oil, coolant and hydraulic applications.

The colorful four-page booklet also contains specifications of sizes and flow capacities of the company's aircraft filter line and is available from Air-Maze Corporation, a subsidiary of Rockwell-Standard Corporation, 25000 Miles Road, Cleveland 28, Ohio.

BULLETIN ON ALL-STAINLESS-STEEL FILTERS ANNOUNCED

All-stainless-steel filters and filter elements are described in a free bulletin from Micro Metallic Division of Pall Corporation, Glen Cove, N. Y. The bulletin lists the availability of porous stainless steel SURFAMAX filters designed for maximum filter surface in minimum volume.

Stock and non-stock filters and elements are listed. Methods of specifying filter area requirements are shown, with special emphasis on flow rates and porosity grades. Characteristics of high pressure filters and other specialized filters and filter elements are described.

For the free literature, Release M-213A, write to Micro Metallic Division, Pall Corporation, Glen Cove, N. Y.

BULLETIN DESCRIBING NEW INSTRUMENT BEARING SERIES ANNOUNCED

High precision thin-width instrument bearings, designed for use in synchros, gear trains, potentiometers, servos and small motors, are described in bulletin available from Miniature Precision Bearings, Inc.

Featuring a high outside diameter/width ratio, the new MPB bearings were developed originally for use in synchros where precision and reliability are prime requisites. Found to be suited for other applications, nine thin-width bearings were incorporated into a standard series which is available without premium charge. The relatively large O.D. enables designers to use economical through-bored and through-ground housings, resulting in more efficient production and improved bearing alignment. The narrow width of the new bearings saves space, making possible the use of longer stators and rotors in synchros and small motors, increasing power without adding to the overall length or diameter of the unit.

Made to ABEC class 7 tolerances, thin-width bearings are available from MPB factory and area office stocks in nine sizes with outside diameters from .2750" to .5000" and bores from .0937" to .1875". The new bearings are manufactured to the same exacting specifications as standard MPB bearings. For this reason the thin-width bearings have the same levels of low torque and the smooth running characteristics of other MPB bearings. Standard material for balls and rings is 440C stainless steel. Open, single and double-shielded bearings are included in the series.

Complete details on thin-width bearings are given in the new Bulletin 6002 from Miniature Precision Bearings, Inc., Precision Park, Keene, N. H.

MODULAR INSTRUMENTS CATALOG OFFERED

The RSCo 600 Series of modular instruments for gas chromatography is illustrated and described in the first complete catalog of the modular units, issued by Research Specialties Co, the manufacturer. The fully indexed 69-page catalog presents 22 modules and 21 other units and accessories. Several gas chromatography systems are illustrated from the many combinations made possible by the modular design. The catalog contains a specifications section conveniently separate from the text and adjacent to the price list. Copies are free on request from Research Specialties Co., 200 S. Garrard Blvd., Richmond, Calif.

CATALOG OFFERED ON HEAVY DUTY PRECISION BALL BEARINGS

Type HDR high-precision radial ball bearings, with load capacities from 19% to 55% greater than equivalent size Conrad bearings, are described in Catalog 60, now available from Split Ballbearing, Lebanon, New Hampshire.

The new bearings, manufactured by the Split Ballbearing single fracture method, reportedly utilize maximum ball complements for higher load capacities, up to 298% greater life expectancy, and 20% less radial deflection than Conrad types of equal size. Full depth races, with no loading slots, enable HDR bearings to carry thrust loads from either direction. In applications where space is a critical factor, it is claimed that a smaller HDR bearing will give equal or greater load capacity and life expectancy than a conventional Conrad type.

Offered in ABEC-3 and ABEC-5 precision grades, the new bearings are made in Extremely Light, Extra Light, Light and Medium Series in metric sizes to 85 mm O.D. Four ranges of internal clearance are available.

Complete engineering information on the new HDR series is given in Catalog 60, Split Ballbearing, Division of MPB, Inc., Lebanon, N. H.

Better Greases Through BAROID RESEARCH

BARAGEL* gives more efficient gel structure —in a greater variety of oils

BARAGEL, a non-soap grease-gelling agent, gives high gel structure in a great variety of oils. This versatility is the result of constant research in Baroid Chemicals' Houston Laboratories. BARAGEL greases are compounded and subjected to the most rigid testing.

One of these tests measures oxygen absorption to determine the resistance of BARAGEL greases to oxidation. BARAGEL greases are easily inhibited with a variety of antioxidants to provide excellent oxidation resistance. Such greases show minimum oxygen absorption under the most rigorous operating conditions.

BARAGEL is a reaction product of mixed organic ammonium halides and refined sodium montmorillonite. BARAGEL is a member of the BENTONE* family of products which has been outstandingly successful in lubricating greases, paints, plastics, inks and other fields.

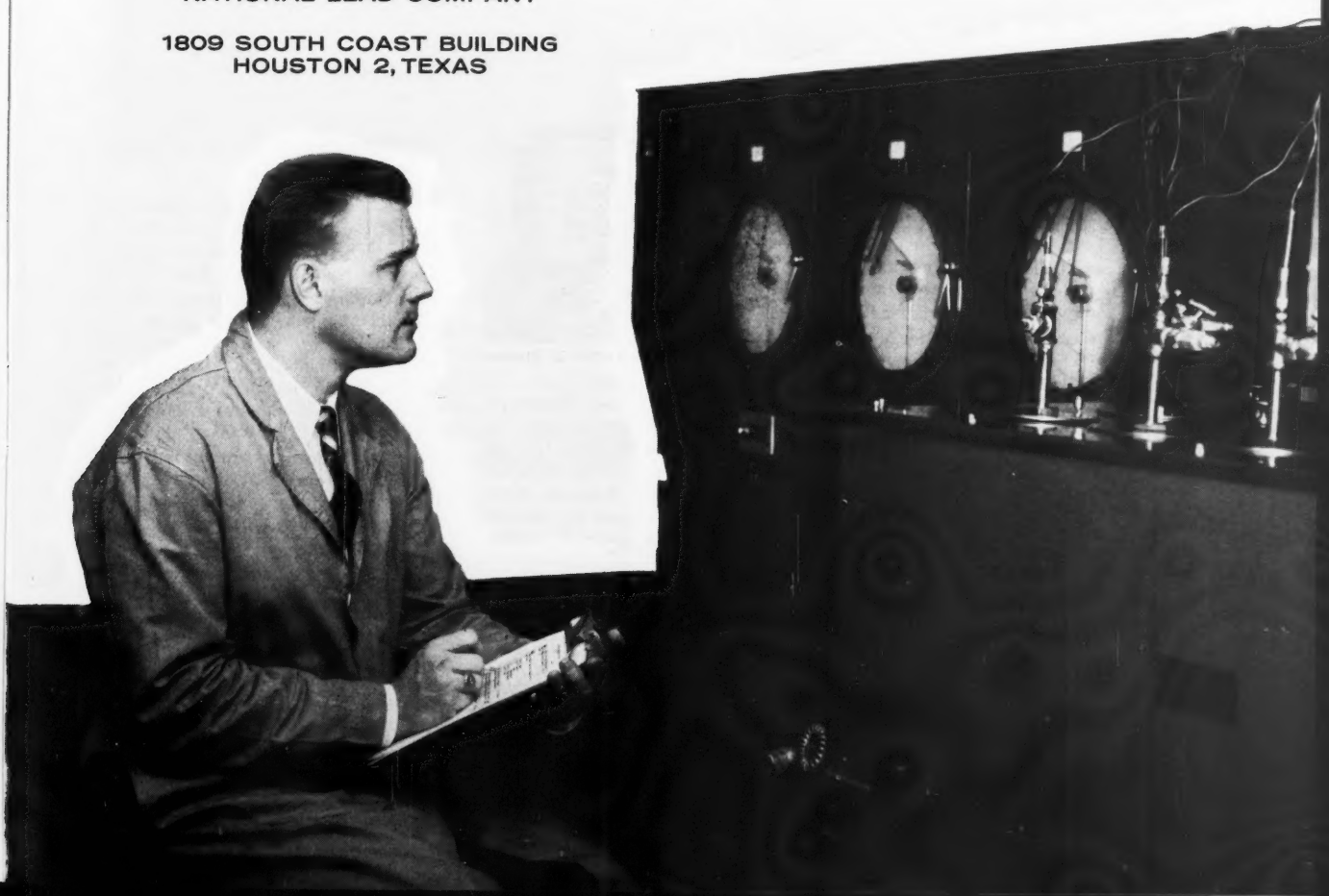
* Trademark of National Lead Company for an organic ammonium montmorillonite

6063

BAROID CHEMICALS, INC.

A SUBSIDIARY OF
NATIONAL LEAD COMPANY

1809 SOUTH COAST BUILDING
HOUSTON 2, TEXAS



PERSONALS

New Hampshire Ball Bearings, Inc., Peterborough, N. H., announces the election of Carl F. Graesser, Jr., to the new staff post of Director of Research. Mr. Graesser, formerly Northeastern Regional Manager for Sales, and an engineering graduate of Brown University, will direct research and development activities for new product design, materials, conditions of operation, and advance manufacturing processes for the miniature instrument bearing firm. Fuller use of the long-established Research Center located in Peterborough is expected from this action. Promoted to Northeastern Regional Manager replacing Mr. Graesser is Donald J. Knizak, formerly Sales Engineer in the New Hampshire Company's Eastern Region headquarters in Great Neck, N. Y.

W. R. Timken was elected President of the Timken Roller Bearing Company recently at the Company's Annual Meeting. He succeeded D. A. Bessmer, who had resigned because of ill health. Elected to the Board of Director at the Timken Roller Bearing Company's Annual Meeting were G. L. Deal, Secretary-Treasurer of the Company; P. J. Reeves, Vice President in charge of Sales; and Henry Tobey, Vice President in charge of Manufacturing, Bearing and Rock Bit Division.

Joseph T. Bonner has joined the industrial division of the Joseph Dixon Crucible Company, Jersey City, N. J., as a lubrication engineer. He will assist industrial salesmen in developing colloidal graphite accounts, field test new products and their applications, and supervise and develop technical bulletins and literature dealing with products manufactured by the company, which include industrial lubricants, paints and crucibles.

The Atlantic Refining Company has announced the appointment of Lincoln Atkiss as director of marketing personnel. He succeeds F. N. Mann who was recently named manager of the firm's purchasing department.

George Cameron has joined the Acar manufacturing organization as Vice-President—General Manager of the Acar Machine and Tool Company affiliate in Roseville, Michigan. The announcement was jointly made by A. T. Tarby and W. M. Reid, partner-owners of the machine and tool company and the parent firm, Acar Broach Company in East Detroit.

William A. Case has joined the Detroit sales office of Parker-Hannifin Corporation, according to an announcement by T. H. Thoresen, field sales manager. Mr. Case, working under the direction of Ivan Shuel, regional manager in Detroit, will be concerned with representation of Parker-Hannifin industrial pneumatic and hydraulic products, including power cylinders, valves, accumulators, tube and hose fittings, presses and riveting machinery.

A series of organizational changes in Du Pont's Petroleum Chemicals Division have been announced. William T. Robinson, head of the Products Application and Service Division at the company's Petroleum Laboratory, Deepwater Point, N. J., was transferred to the Wilmington office as technical assistant. He was succeeded by Robert O. Braendle, technical manager of the eastern region with headquarters in New York. Mr. Braendle, in turn, was succeeded by George A. Finn, assistant technical manager of the eastern region. At the same time, the company announced the transfer of **J. Brent Malin,** technical manager of the western region, to the Petroleum Laboratory in the newly created position of head of the Technical Information Division. Anton O. Melby, technical assistant of new product development, succeeded Mr. Malin as technical manager of the western region.

H. EDWARD EHLERS

WARREN A. ZIMMER

H. Edward Ehlers and Warren A. Zimmer, have been elected executive vice presidents of the Joseph Dixon Crucible Co., Jersey City, N. J., it has been announced by Frank G. Atkinson, president. Both Mr. Ehlers and Mr. Zimmer had formerly been a senior vice president.

Alexander Kidd has been elected president of Girdler Construction Corporation, Louisville, Ky., a subsidiary of Chemical and Industrial Corp., Cincinnati. The company designs, engineers and constructs processing plants for the chemical, petroleum, natural gas and other industries.

John A. Farris has been named manager of engineering liaison by Aircraft Porous Media, Inc., a subsidiary of Pall Corporation, Glen Cove, N. Y. Aircraft Porous Media (APM) manufactures precision filters in the low micron ranges for aircraft and missiles, and ground support applications. In the newly created position of manager of engineering liaison, Mr. Farris will be responsible for providing the technical support of Aircraft Porous Media for users and potential users of APM products.

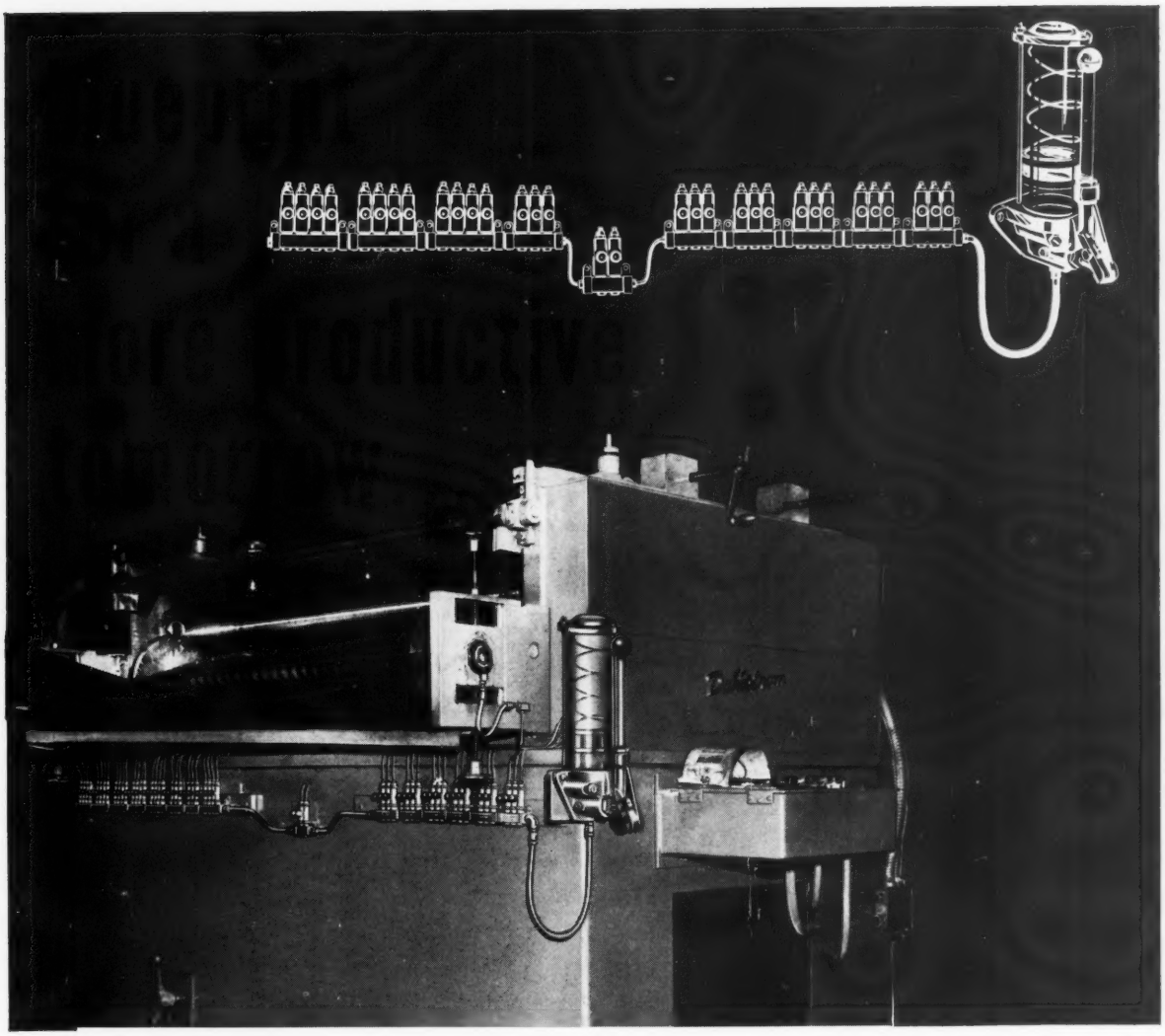
JOHN A. FARRIS

LINCOLN D. HALL

The appointment of Lincoln D. Hall as manager of its newly created Midwest district with headquarters in Kansas City, Mo. has been announced by the Tube Turns division of Chemetron Corp. Mr. Hall, who has had extensive experience in construction, petroleum and industrial equipment industries, is in charge of sales in a ten-state territory that includes Colorado, Kansas, Missouri, Nebraska, North and South Dakota and Wyoming and portions of Illinois, Iowa, and Montana.

H. S. Cain has been named sales manager of Berry Hydraulics, a Division of Oliver Tyrone Corporation. He formerly was district sales manager. Mr. Cain will be based at Berry's general sales office in Corinth, Mississippi, where he has been located for two years. He previously serviced accounts from Houston and Pittsburgh. In his new capacity, Mr. Cain will have supervision of Berry's sales of heavy duty rotating piston pumps, gear pumps, motors and transmissions used in the OEM and industrial fields, as well as hydraulic auxiliaries for use in the oil and gas industries.

Appointment of Mr. Samuel Kruty, as Production Manager has been announced by Dearborn Chemical Company, Chicago. In his new position, Mr. Kruty will head up manufacturing operations for all Dearborn product lines. He will maintain offices at the company's main plant in Lake Zurich, Illinois, as well as at Dearborn's Chicago plant.



A *Lincoln* Centralized Lubrication System

In seconds a Lincoln Centralized Lubrication System lubricates all bearing surfaces while machinery is operating. It assures that every bearing gets the right amount of lubricant at the right time, whether you use the simpliest, manually-operated CentrOluber* or a completely automatic CentrOmatic* System. Centralized lubrication cuts downtime and bearing replacement, boosts plant efficiency and production.

Lincoln systems can be actuated by hand, reciprocating motion, air or electricity. There are 26 systems available to meet every lubricant application requirement . . . including *yours*. Mail the coupon today for complete details and specifications.

*Registered Tradename.

Coast-to-Coast Sales and Service through 16 Branch Offices and Leading Industrial Distributors.

1046

Lincoln

LINCOLN ENGINEERING CO
Division of The McNeil Machine & Engineering Co.
St. Louis 20, Missouri

LINCOLN ENGINEERING CO.
5738 Natural Bridge Ave., St. Louis 20, Mo.

Please send my complimentary copy of Catalog 81 on Lincoln Centralized Lubrication Systems.

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

BOOK REVIEW

G. H. Clark, "Marine Lubrication," Simmons-Boardman Publishing Corporation, N. Y. C., 1959, 635 pp., $16.00.

This is perhaps the most complete treatment of the subject of Marine lubrication that has ever been presented in one book. The title itself does not prepare the reader for all of the "extras" or related items which are discussed therein. Furthermore, it is completely up to date and covers the very latest developments in prime movers.

The first few chapters present general background information on such things as lubricants and greases and tests used to characterize them, the basic principles of lubrication, a discussion of journal and ball and roller bearings, and a detailed discussion of the various methods for maintaining both lubricants and fuels in proper condition.

This is followed by the thorough and comprehensive treatment of the lubrication of the prime movers. These discussions are not limited to the conventional reciprocating steam engines, steam turbines and diesel engines, but include the latest developments in the free piston engines, the gas turbine and nuclear propulsion systems. Not only is the lubrication of these prime movers covered in considerable detail, but the prime movers themselves are described very adequately. Many of the problems encountered in the operation of these systems are dealt with quite extensively, as for example, corrosion in both steam turbine systems and diesel engines, crankcase explosions in diesel engines, and gear difficulties, to cite a few. Many of these problems, such as the EP turbine oil situation and the liner wear in diesels, are quite controversial, and it must be expected that everyone will not agree with all of the opinions expressed by the author. Other major items covered in the discussions of prime movers include gear designs, piston and piston ring design, and fuels and heavy duty, detergent oils for diesel engines.

To complete the story, the final chapters deal with the lubrication of all of the auxiliary equipment including, pumps, generators, air compressors, refrigeration equipment, steering gears, deck machinery, etc.

It is believed that this book will be most valuable to engineers and others concerned with operating of a power plant and auxiliary machinery, whether it be on a ship or on land.

(Reviewed by R. K. Gould, Research and Technical Department, Texaco, Inc.)

SOCIETY NEWS

New ASLE Members—April, 1960

CHICAGO SECTION

WILLIAM F. COUSER
Celanese Chemical Co.
Park Forest, Ill.
BRUCE W. GLENN
L. R. Kerns Co.
Chicago, Illinois
ROBERT R. REID
Cities Service Oil Co.
East Chicago, Indiana
ARTHUR A. WARFORD (R)*
Macco Products Co.
Chicago, Illinois

MILWAUKEE SECTION

JERRY L. RICHLAK (R)*
Butler, Wis.

CLEVELAND SECTION

JOHN L. BATES
The Standard Oil Co. (Ohio)
Cleveland, Ohio
THOMAS C. JONES
Jones and Laughlin Steel Corp.
Cleveland, Ohio

PITTSBURGH SECTION

WARREN H. HOWARD
Morgan Construction Co.
Pittsburgh, Pa.

LOS ANGELES SECTION

ROBERT B. BOOTHBY
Lincoln Engineering Co. of Calif.
Los Angeles, Calif.
PAUL C. MARX
Paper Mate Mfg. Co.
Santa Monica, Calif.

NEW YORK SECTION

W. WAYNE ALBRIGHT
Shell Oil Co.
Flushing, New York
JOHN A. FARRIS
Aircraft Porous Media, Inc.
Subsidiary of Pall Corp.
Glen Cove, L.I., New York
RICHARD F. FINN
Esso Research and Engineering Co.
Enjay Laboratories
Linden, New Jersey
JOHN H. LOHMAN
Shell Oil Company
Mount Vernon, New York
CARL C. STEIN
Hercules Packing Corp.
Alden, New York

PHILADELPHIA SECTION

ROBERT H. ACHESON
E. F. Houghton and Co.
Philadelphia, Pa.
WILLIAM A. MOLIN
Gulf Oil Corp.
Philadelphia, Pa.

DAYTON SECTION

WILLIAM P. CULVER
The Standard Oil Co. (Ohio)
Dayton, Ohio
WALLACE J. KEITH (R)*
Acheson Colloids Co.
Dayton, Ohio

HOUSTON SECTION

ARTHUR J. JOHNSON
T. F. Hudgins and Assoc., Inc.
Houston, Texas

ST. LOUIS SECTION

ERNEST G. GIVENS
Alpha Portland Cement Co.
St. Louis, Mo.
JULIAN G. WALTERS
Ford Motor Co.,
St. Louis, Mo.

INDIANAPOLIS SECTION

HAROLD W. McCOY
Delco-Remy Div. GMC
Anderson, Indiana

BALTIMORE SECTION

HERBERT M. HUTCHINS
United Oil Co., Inc.
Baltimore, Md.
D. R. KINCAID
Shell Oil Co.
Silver Spring, Md.

BOSTON SECTION

HUGH A. LADNER
Texaco, Inc.
Brookline, Mass.

SAGINAW VALLEY SECTION

FRAN BARBEAU
Cox Sales and Engineering
Detroit, Michigan

TORONTO SECTION

HENRY R. BADOWSKI
Warner-Lambert
Toronto, Ont., Canada
STEWART W. MATTHEWS
Shell Oil Co. of Canada Ltd.
Toronto, Ont., Canada

LOUISVILLE SECTION

DONALD E. SCHNEIDER
Shell Oil Co.
Louisville, Kentucky

INTERMOUNTAIN SECTION

HAROLD C. BISHOP, JR.
Continental Oil Co.
Salt Lake City, Utah

DALLAS-FORT WORTH SECTION

KENNETH H. DAY
Lubrication Engineers, Inc.
Fort Worth, Texas
L. DON DODSON
Lubrication Engineers, Inc.
Fort Worth, Texas

RICHMOND SECTION

WILFRED D. TOWNSEND
E. I. du Pont de Nemours and Co., Inc.
Richmond, Virginia

UNAFFILIATED SECTION

EMIL G. BRENDEL
Hammerhill Paper Co.
Erie, Pa.
E. S. CAIN
AiResearch Mfg. Co. of Arizona
Phoenix, Arizona
GARNETT W. MOORE
Dan River Mills, Inc.
Danville, Virginia

**Reinstatements*

Vol. 16, No. 6

Lubrication Engineering

the industrial lube market

. . . for many, many years the stepchild—industrial lubes are now accepted as a full-fledged member of the family. The evidence: a report in a recent issue of *Printer's Ink* (magazine of advertising and marketing) entitled, "Giants Grapple for Industrial Lube Sales." "Major oil companies," according to the article, "are expanding and revising ad programs to grab bigger shares of . . . industrial lubricant market. New tack for most ad strategies: alerting management to lubrication's effect on profit. Some companies are using case histories to dramatize savings that can result from "correct lubrication," one other pounds home the point that "lubrication is a major factor in cost control," while others are casting about for fresh approaches.

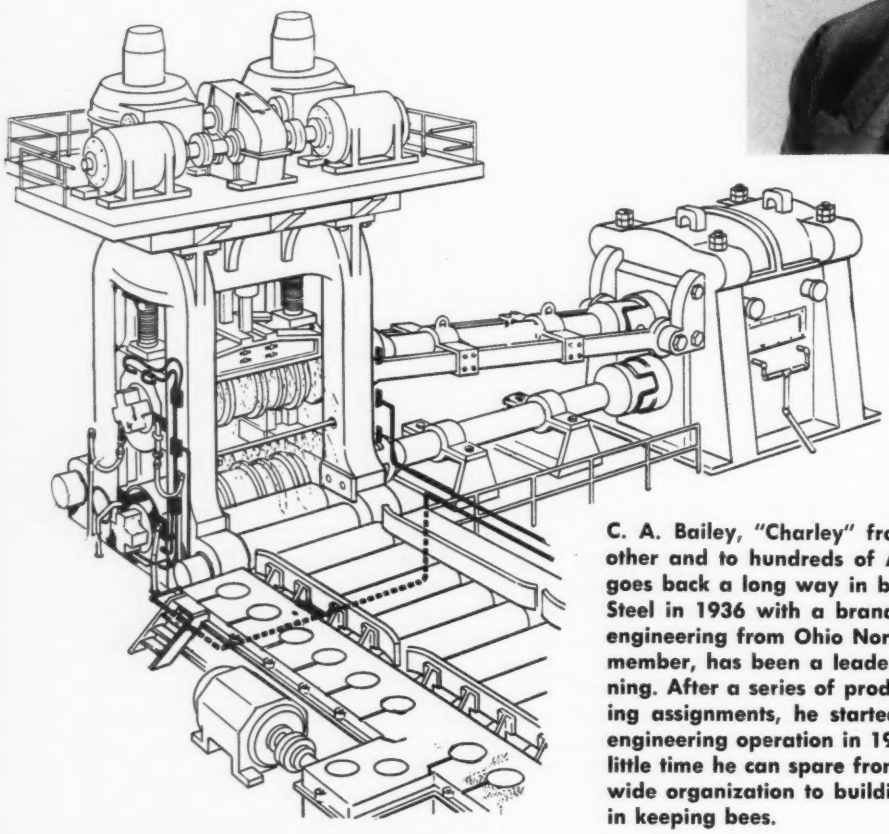
It was pointed out that in 1959, 206 different companies took a total of 3,752 pages of industrial lubricant ads in 212 business magazines, which represents an increase over 1958 of better than 400 pages by more than 60 companies. There is little doubt that industrial lubrication is at long last being recognized for it's worth. This is, indeed, what ASLE has been saying in it's 15 years of existence. Perhaps it has not been as succinct and pointed as the ad experts, but nevertheless, the basic thought is the same. Just last year, ASLE commenced the preparation of a series of articles, "The Lubrication Engineer in Action," which point out the tremendous savings available to industry through the services of a lubrication specialist. The first of the series was published in *Lubrication Engineering*, April, 1960. The second in the series is in this issue. When one sees the success of lubrication engineers who have saved companies thousands and thousands of dollars through an organized lubrication program, this should help the oil companies get their story to management. ASLE's role is to make more expert the lubrication engineer, in whose functional area, the responsibility of lubricant application falls.

One other thought occurred when reading this survey. How many of the 3,752 pages of advertising appeared in *Lubrication Engineering*—the companion of the Lubrication Engineer? All too few, it is sad to report. It seems strange that the "bible of the industry" is so sadly neglected, since it reaches the bulk of those charged with the responsibility for lubrication. The marketers of industrial lubricants would do well to lay even a broader foundation of alerting management to lubrication's effect on profit and where else could this be accomplished so readily as in *Lubrication Engineering*.

L. O. Witzenburg
President, ASLE

THE LUBRICATION ENGINEER IN ACTION

C. A. BAILEY
Lubrication Engineer
National Tube Division



C. A. Bailey, "Charley" from one end of U. S. Steel to the other and to hundreds of ASLE members across the country, goes back a long way in both organizations. He joined U. S. Steel in 1936 with a brand new B. S. degree in mechanical engineering from Ohio Northern University and, as a charter member, has been a leader in the ASLE from its very beginning. After a series of production and maintenance engineering assignments, he started his present full-time lubrication engineering operation in 1950. Since then, he has spent what little time he can spare from staying in touch with his nationwide organization to building a ground level penthouse and in keeping bees.

BLAST FURNACE—DUQUESNE WORKS, UCO

Report No. 2

CHARLES A. BAILEY
at the National Tube Division of U. S. Steel

To tell a general story of lubrication engineering at U. S. Steel would actually require the telling of 49 different stories covering 49 different procedures with 49 different men in charge. Each story would detail the activities of an individual directly responsible for efficient application of constantly improving lubrication techniques and materials at one or another of the Corporation's operations, ranging from ore handling in subartic climates to precision machining in air conditioned tool rooms.

Yet, despite the magnitude of such an undertaking, Charley Bailey compiles such a story at least once a year. How he does it, and how he maintains continuity and uniformity of lubrication practices throughout one of industry's largest and most complex organizations, is really the "inside" story of lubrication engineering at U. S. Steel . . . and one that can be told here.

First, a quick look at the general organization of lubrication within the Corporation will help bring the story into focus. Bailey and his immediate staff, consisting of two field engineers, a training specialist, a technical illustrator, an experienced chemist and a secretary, are based in the Steel Building in Pittsburgh, the home of U. S. Steel. Specifically, the function comes under the jurisdiction of the National Tube Division. Bailey reports directly to the Operating Vice President.

But this home office set-up is only a small part of the overall lubrication engineering structure. In addition to Bailey's immediate staff, one man in every key plant throughout the Corporation has a definite assignment in connection with lubrication engineering. These men, while directly responsible to local operating management wherever they are situated, are in close communication with Bailey on all matters concerning lubrication and rely on him and his staff for technical assistance, testing and general guidance.

The composition of this field staff varies widely from plant to plant and from time to time. Where lubrication is highly critical in a plant operation, the man in charge will actually carry the title of lubrication engineer. In other cases, lubrication engineering is a corollary assignment and may be attended to by a tool engineer, a turn foreman or even a maintenance superintendent.

It has also been found that the responsibility for lubrication engineering is extremely valuable training experience for future management personnel, taking a man into every section of the plant and giving him broad familiarity with every type of equipment and process. Consequently, some portions of Bailey's field staff are constantly changing as men move up and newer men take their places.

At present, the composite staff lubrication engineer comes from virtually every state in the Union or even from oversees, has been with U. S. Steel from six months to 40 years. Educational backgrounds range from degrees in E.E., M.E. or even P. E. to years in the graduate school of experience and outside interests range from horses to hypnotism.

The essential problems confronting Bailey in exercising general corporation-wide supervision of lubrication practices with this type of organizational structure are obvious. To provide for continuity of practice, uniformity of application and co-ordination of results requires a highly developed system of training, communications and cooperation that is original at U. S. Steel and virtually unique in industry.

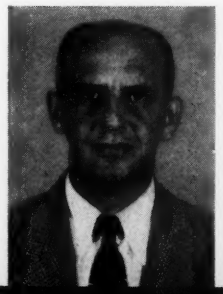
But before going into the details of how the problems are solved, the less obvious *benefits* of such a lubrication engineering organization should be pointed out. First, the diversity of backgrounds, talents and experience represented on the staff helps find the best solution to almost any problem in far less time and with far greater certainty than could be achieved by any single specialist.

For instance, could any one individual solve all of the separate problems of special equipment selection and design, material testing and specification and revised delivery and storage arrangements involved in installing a bulk grease handling system for automatic lubrication of a battery of blast furnaces? Working together, the U. S. Steel lubrication engineering staff has applied the economies of bulk grease handling (automation, reduced storage and handling cost, decreased material loss due to incomplete drum cleanout) in almost all of the corporation's plants in less than two years.

Also, during the same period, other activities in various plants have resulted in literally hundreds of specific improvements ranging from a lubricant change that extended roll life, showing a substantial savings, to a new procedure for crane rail lubrication that has already decreased crane wheel wear considerably.

The other major benefit resulting directly from the complex and seemingly loose-knit organization of the U. S. Steel lubrication engineering staff is close liaison with operating management throughout the

J. S. AARONS
Lubrication Chemist
Lub. Testing Lab., NTD

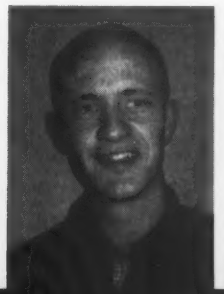


C. R. BURTON
Asst. Chief Engineer
Oliver Iron Mining Div.

W. C. CASLEY
Diesel Locomotive Inspector
Union Railroad Company

R. J. CHRISTIAN
Lub. Training Engineer
Lub. Testing Lab., NTD

J. B. COWDEN
Lub. Eng., Pittsburg Works
Columbia Geneva Steel Div.



LUCIE CROWE
Secty. to C. A. Bailey, NTD

F. L. DILLARD
Mechanical Engineer
Lynch District, UCO

W. E. ELLIOTT
Lubrication Engineer
Edgar Thomson Works, UCO

E. J. EYRING
Design Engineer
Fairless Works, NTD

A. J. B. FAIRBURN
Supv., Mtce. Tech. Serv. Dept.
Lorain Works, NTD

corporation. The fact that each man responsible for lubrication engineering reports directly to local supervision keeps operating management thoroughly involved and solidly behind lubrication engineering activities. This close tie with local management helps turn simple recommendations into directives that will mean actual cost savings. It works so well that the corporation-wide maintenace committee actually comprises an ex-offlcio "board of directors" to oversee the lubrication engineering function.

The principal problems to be solved are (1) continuity of the lubrication engineering activity despite internal turnover in personnel, (2) coordination of all activity on a corporation-wide basis and (3) the interchange of up-to-date information on improved methods and materials that have been investigated and proved out.

To solve these problems, Bailey relies on a continuous program of training, a comprehensive lubrication manual that has become almost a standard reference source in lubrication engineering circles and a regular system of intra-company communication.

The training program is built around the U. S. Steel Mobile Training Unit, a specially designed, air-conditioned classroom on wheels. Modular arrangement of interchangeable demonstration panels within the unit makes it possible to explain the action of any type of centralized lubricating system in use in any U. S. Steel plant.

All demonstration set-ups are fully operational and the modular plan permits easy revision of the material to be presented to suit the specific needs of any group.

A typical tour for the training unit begins with a request from a resident lubrication engineer for time on the training unit traveling schedule. He also prepares an outline of his proposed training program for approval by the Tube Division's Director of Education, detailing his training objectives.

Subsequently, the training unit is sent to the requesting plant, in many cases accompanied by the training specialist from Bailey's own staff. Classes consist of approximately 15 men each and may be made up of maintenance, operating or engineering personnel as determined by local plant management.

Incidentally, while enroute from one scheduled instruction session to another, special "quickie" presentations are frequently made at the request of U. S. Steel plants wishing to consider the possibility of a lubrication training program. And as a gesture of business friendship, the mobile training unit is often shown to outside companies or made available for special conventions and technical meetings. It was a center of attention at the April ASLE meeting in Cincinnati.

The result of this unusually well equipped training program is a very noticeable increase in the general appreciation and understanding of proper lubrication practices throughout the company. Highly practical benefits have been reported too.

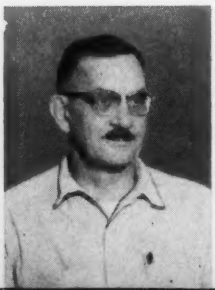
In one case, specific training in connection with the automatic oiling system of a large rolling mill saved several hours of down time in tracing and correcting a lubrication failure. At the current minute cost of operation of such a large production unit, even one such case is quite significant.

J. O. FELTON
Maintenance Supt.
Lynch Dist. Mine, UCO

G. FRYE
Practice Engineer
Christy Park Works, NTD

F. L. GRAY
Lubrication Engineer
Gary Steel Works, UCO

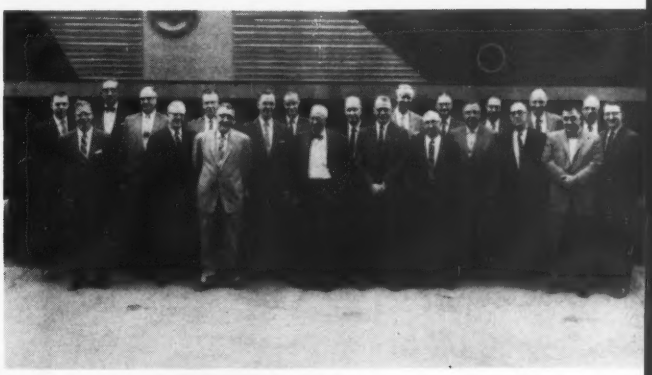
E. C. GROVES
Lubrication Engineer
Ellwood Works, NTD



W. E. HAMILTON
Lubrication Engineer
Tenn. Coal & Iron Div.

United States Steel employees learn proper maintenance of plant lubrication in this mobile training unit.

Maintenance Committee—"Board of Directors"



Fifteen or more persons can be seated comfortably for demonstrations inside the mobile training unit which is being used by U. S. Steel to instruct employees in maintenance of plant lubricating systems. Built by National Tube Division, the 35-foot vehicle contains operating components of centralized lubricating systems. Here, John Simon, National Tube lubrication engineer, and V. C. Sutcliffe, general supervisor of training at National Tube's National Works, demonstrate a system to employees of National Works.

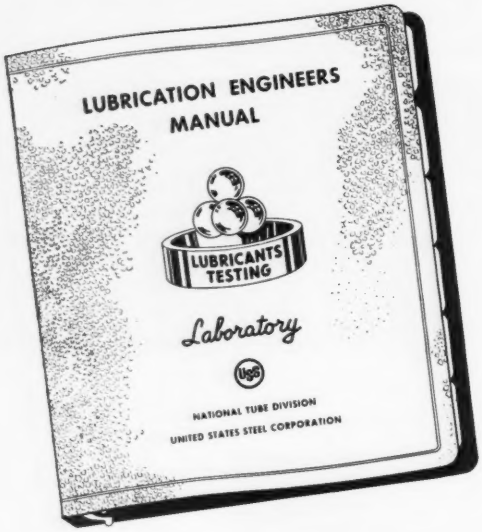
J. H. HERSHISER
Tool Engineer
Johnstown Works, UCO

H. E. HILLYARD
Maintenance Engineer
Lorain Works, NTD

W. HOEWISCHER
Turn Foreman
South Works, UCO

R. J. HUET
Technologist
Applied Research Lab., UCO

V. E. JOLL
Lubrication Engineer
Homestead Works, UCO

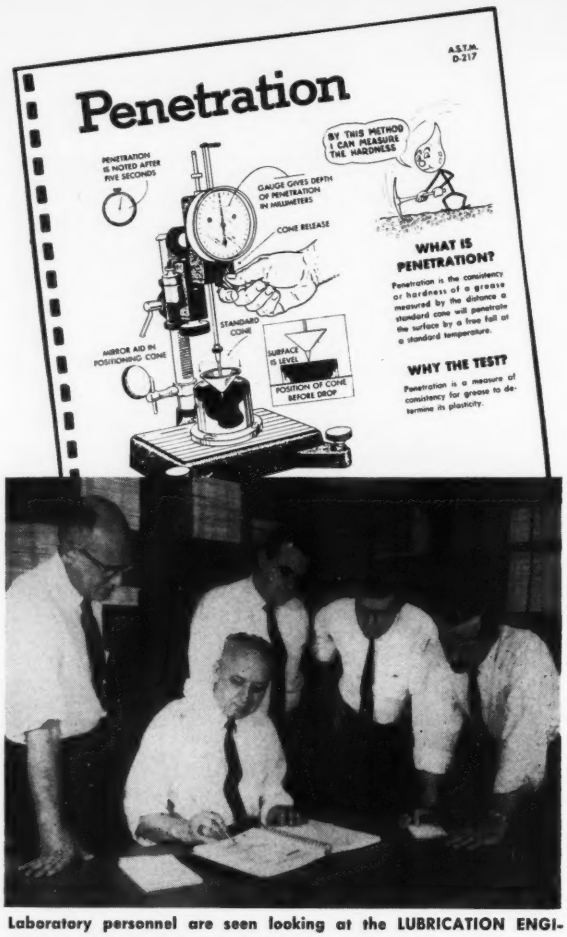


The U. S. Steel Lubrication Engineers' Manual, prepared and constantly revised by Bailey's staff, is a complete compilation of all U. S. Steel requirements for various types of lubricants, detailed descriptions of the tests by which characteristics are determined and general instruction on lubricant application and lubrication equipment. Fittingly referred to as the "bible", the manual gives every lubrication engineer up-to-date guidance in the selection of materials and equipment and even goes a long way toward suggesting problem solutions and possible improvements.

Most important of all, however, the manual provides a consistent basis for company-wide uniformity and continuity of practice in spite of widely divergent types of operations and personnel changes.

Another aspect of the U. S. Steel Lubrication Engineers' Manual is the care taken in its preparation to permit the greatest possible latitude and efficiency in procurement. Requirements for various types of lubricating materials are set forth in terms of "bench marks" rather than as rigid specifications.

Under this arrangement, the lubrication engineer is not required to make decisions concerning brand selection. Rather, he describes his needs in terms of the applicable "bench marks" and the purchasing section is then free to procure any materials that meet the requirements.


Penetration
A.S.T.M. D-217
BY THIS METHOD I CAN MEASURE THE HARDNESS
PENETRATION IS NOTED AFTER FIVE SECONDS
GAUGE GIVES DEPTH OF PENETRATION IN MILLIMETERS
CONE RELEASE
STANDARD CONE
MIRROR AID IN POSITIONING CONE
SURFACE IS LEVEL
POSITION OF CONE BEFORE DROP
WHAT IS PENETRATION?
Penetration is the consistency or hardness of a grease measured by the distance a standard cone will penetrate the surface by a free fall at a standard temperature.
WHY THE TEST?
Penetration is a measure of consistency for grease to determine its plasticity.

Laboratory personnel are seen looking at the LUBRICATION ENGINEERS MANUAL. Seated: R. R. Wayne; standing, left to right: J. S. Aarons, J. J. Seaton, R. J. Christian, W. M. Schrey.

The principal contact between U. S. Steel lubrication engineers and lubricant suppliers is in connection with specific development projects or in determining the technical compliance of certain materials with basic physical requirements.

In addition to his work in connection with the mobile training unit and the manual, Bailey also maintains regular and systematic contact with the field lubrication engineers by means of an annual meeting, specially prepared Methods Improvement Pointer bulletins and procurement schedule summaries. These latter are reports, filed by the field men, which keep Bailey posted on how much of what material is being used for each purpose in each plant.

R. D. KEECH
Lub. Foreman, Western Dist.
Oliver Iron Mining Div.

T. J. KELLY
Mtls. Spec. Coordinator
Frick District Mine, UCO

C. B. KIMPEL
Mtce. Development Supv.
Duquesne Works, UCO

J. C. LEIS
Lubrication Engineer
Clairton Works, UCO

J. LONGAZO
Foreman, Pipefitters
Gary Steel Works, UCO

I. M. MARR
Mtce. Engineer
Univer. Atlas Cement Div.

C. H. McGUIRK
Supt., Mtce. Terminal
Quebec Cartier Mining Co.

A. OLSEN
Mtce. Engineer
American Steel & Wire Div.

C. W. PEHLE
Asst. to Div. Supt. Mtce.
South Works, UCO

C. E. POLICK
Safety Engineer
Irvin Works, UCO

At the annual meeting, usually a two day seminar held in Pittsburgh, the results of current lubrication research and development work are explained to the assembled staff and each field engineer presents a personal report on his own current activities and achievements. The result is a productive, informal exchange of information and, when transcripts of all the reports are compiled, a complete annual report of lubrication engineering progress. This is the overall story described at the beginning of this article and is circulated throughout the corporation.

The Methods Improvement Pointer sheets are brief, cartoon-illustrated write-ups designed to make any lubrication idea that works well in one plant available to every other plant. Subjects covered range from new products that have shown definite advantages in use to basic suggestions in connection with scrap loss reduction and preventive maintenance.

Fundamentally, even beyond the activities described above, all of Bailey's procedures are intended to maintain communication between the field men actually responsible for lubrication engineering and the headquarters office. Excellent laboratory facilities, prompt action on test or analysis requests, and the availability of a competent consultation service and field help have played an important part in establishing the close field-headquarters relationship that now exists.

THE ASSIGNMENT

C. A. Bailey's basic assignment in exercising overall supervision of U. S. Steel lubrication engineering activities is to assure continuing improvement of both the lubricants in use and the methods of application. With the set-up as it now exists, and on a strictly advisory rather than an authoritative basis, he must cause this to happen by supplying the kind of leadership, service and assistance that will encourage the relatively independent field men to collaborate with headquarters.

All oils, greases, synthetics, hydraulic media, and solvents used anywhere within the corporation are his concern. As evidence of performance, he must report annually to management on all phases of his various activities. Naturally, the emphasis is on improvements and changes that have resulted in accredited cost reductions.

On consideration, this would seem to be almost too broad an assignment, one that would easily engulf even the most striking accomplishments and make them seem insignificant. Quite to the contrary, Bailey's approach to this task has produced results that have gone far beyond the confines of U. S. Steel to win recognition throughout the petroleum industry.

THE APPROACH

Covering 49 different operations, each headed up by a different individual with a different background and different management responsibilities, Bailey must really strive to be all things to all people in order to maintain any degree of corporation-wide control. As might be expected, his general approach is as circumspect and diplomatic with regard to local authority as any UN procedure.

J. E. READ
Lubrication Engineer
Duquesne Works, UCO

T. F. REX
Buyer
Purchasing Division, UCO

W. L. ROBERTS
Asst. Div. Chief
Applied Research Lab., UCC

A. R. SALSA
Asst. Supv., Lub. Lab.
Orinoco Mining Company

F. J. SASSMANN
Design Engineer
Gary Works, NTD

A view of the Lubricants Testing Laboratory.

With only a budget and the backing of the maintenance committee, he must instill an attitude of cooperation between headquarters and the field men in every division. Otherwise, there would be no overall lubrication engineering program at U. S. Steel—only, at best, an uncoordinated set of separate operations in separate plants with unavoidable and costly duplication of effort.

Charley Bailey manages to make the job look easy and natural, merely by providing the most complete and prompt technical service, the best counsel and most useful written material that any lubrication engineer anywhere in the corporation could hope for from any source.

THE RESULT

Results are two-fold. First, proved savings as documented in the annual reports pay the costs of the headquarters lubrication engineering operation many times over.

Probably even more outstanding, however, are the intangible gains that accrue to U. S. Steel as a result of coordination of lubrication engineering through the corporation—respect for special competence from those in petroleum producing and processing circles and recognition for leadership throughout industry.

These benefits are not the inevitable reward of mere bigness in the case of U. S. Steel. Rather they are the hard won result of careful planning and effective action under more than usually difficult circumstances. The same results are available to any company through recognition of the importance of lubrication engineering and the establishment of a program designed to suit specific needs.

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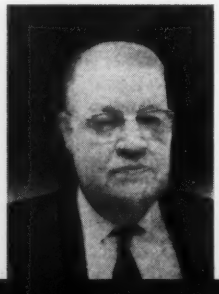

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A Survey of Lubrication Methods

Part 3— Compendium of Lubricating Devices

(Continued)

by Allen F. Brewer*
Consulting Editor

Illustrated by Robert R. Wayne
Pittsburgh, Pa.

In the last issue a discussion was begun of the main features of typical lubricating devices. The discussion will continue in the present article and it will be noted that the illustrations have been kept quite schematic to stress the principles of operation rather than the details of construction.

SPLASH LUBRICATION SYSTEM

As shown in Fig. 10, a typical splash system consists of a sump or reservoir into which dips one or more of the moving parts of the machine being lubricated. Oil is splashed to the surfaces requiring lubrication. Very often grooves are provided as shown to distribute oil to those portions of the machine that are not splashed directly. The grooves also facilitate flow of the oil back to the reservoir to permit reuse.

In some cases scoops are fitted to the dipping element to increase the splashing action.

In order to maintain the oil reservoir at the proper level to insure effective splashing, a suitable oil gage is sometimes installed in the reservoir. This may take the form of a sight glass or a dip stick.

RING OILER

The typical ring-type oiler shown in Fig. 11 involves a two-piece bearing housing. The lower half serves as an oil reservoir of up to several quarts capacity according to the size of the shaft and the number of rings.

The ring, which is about 1.5 times the diameter of the shaft, rides on the shaft and is driven by the friction developed between the shaft and the ring. The top half or bearing cap is slotted to a sufficient width and depth to permit free movement of the ring. The ring dips into the reservoir and transports oil to the top of the bearing. Grooves or channels may be provided at this point to distribute the oil axially.

After the oil leaves the bearing, it flows back to the reservoir to be used again.

Ring oilers have provided satisfactory lubrication for 1 and 2 inch diameter shafts at speeds up to 3600 rpm. For larger shafts in the 4 inch diameter range, lower speeds are necessary for good results. Ring oilers are also suitable for lower speed applications down to around 50 rpm.

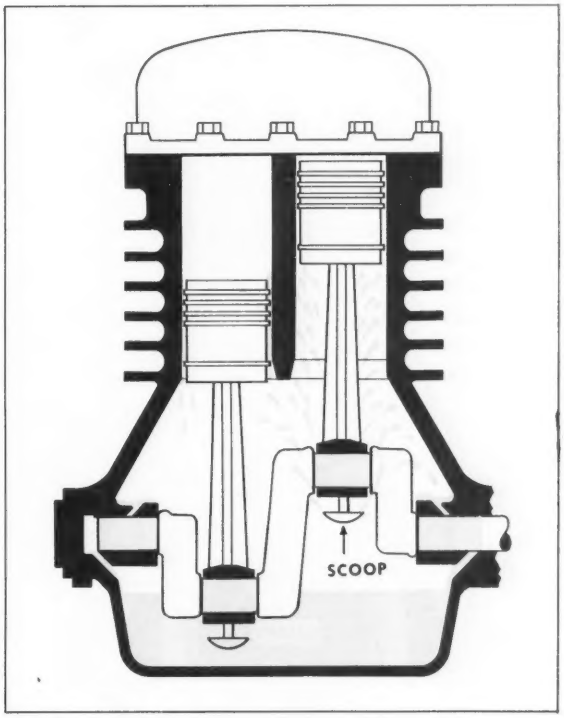

Fig. 10. Splash Lubrication System

Ring oilers are limited to use with horizontal shafts and are unsuited for shafts which may be subjected to excessive vibration that might interfere with the contact of the ring with the shaft.

* Consultant and author "Basic Lubrication Practice."

CHAIN OILER

The chain oiler shown in Fig. 12 is very similar in principle to the ring oiler. The flexible chain has many joints which gives it a greater oil capacity then the oil ring for low speed applications. However, the chain oiler is limited to lower speeds due to the tendency at higher speeds of the chain to lose contact with the shaft due to centrifugal force and because of churning. In addition, chains are subject to breakage when thrown against the side of the casing.

COLLAR OILER

The collar oiler shown in Fig. 13 is a cross between ring oiling and splash oiling. The collar is rigidly fixed to the shaft and turns at shaft speed. To use a collar oiler, the bearing must be divided into two parts. The lower part of the collar is immersed in oil in the reservoir and when the shaft rotates the oil is carried up to the top of the bearing. Scrappers are provided at this point to remove the oil and divert it to the bearing.

Collar oilers are usually used for low speed operation where heavy oils are employed.

WASTE FEED OILER

Fig. 14 shows a typical waste feed oiler such as might be used on a traction motor axle bearing. A pusher plate forces some of the waste packing through a window in the bearing and insures good contact between the packing and shaft. The lower end of the packing is immersed in a reservoir. Provided the oil in the reservoir is maintained between prescribed maximum and minimum levels satisfactory lubrication will result. Provisions are usually made to divert the end leakage back to the reservoir.

UNDER-FEED PAD OILERS

Fig. 15 shows a typical under-feed spring loaded wick oiler such as might be employed to lubricate sliding surfaces on small mechanisms.

The lubricator transports oil from a reservoir to a moving surface by means of the capillarity of the wick. A spring element is employed to insure good contact with the moving surface.

SATURATED PAD OILER

Fig. 16 shows a saturated pad lubrication system such as might be used on small motors. A portion of the wicking material is pressed against the shaft through a window in the bearing. Flingers are sometimes provided on the shaft to throw the oil that leaks from the ends of the bearing back in to the wicking material. In some designs provision is made to add oil to the wicking system periodically. In other designs

Fig. 11. Ring Oiler

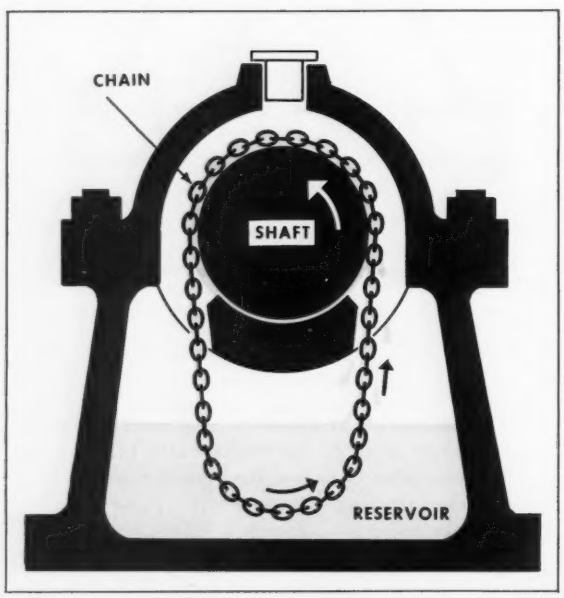

Fig. 12. Chain Oiler

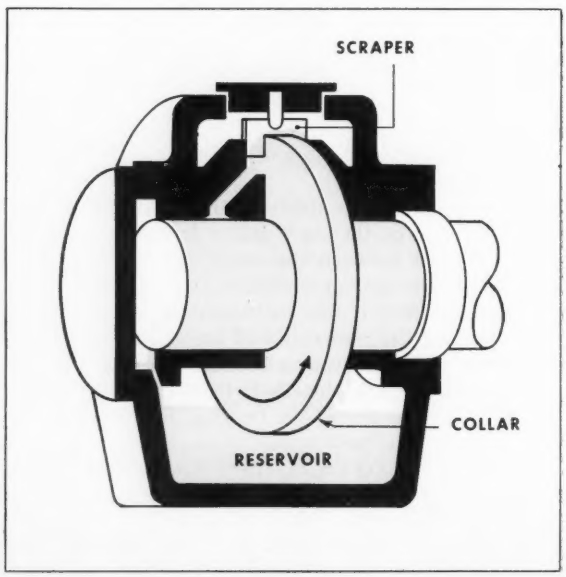

Fig. 13. Collar Oiler

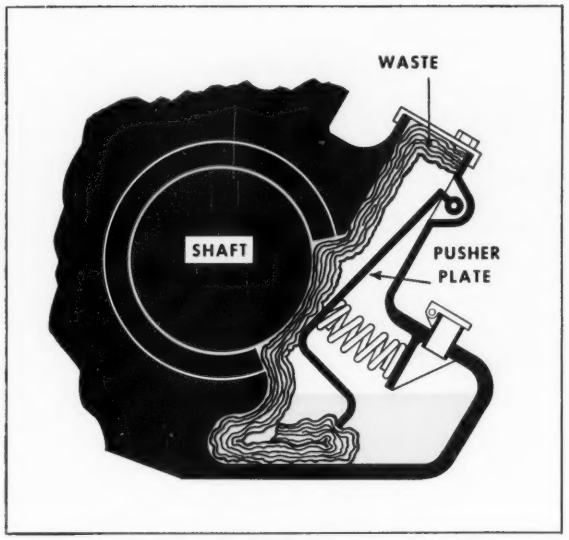

Fig. 14. Waste Feed Oiler

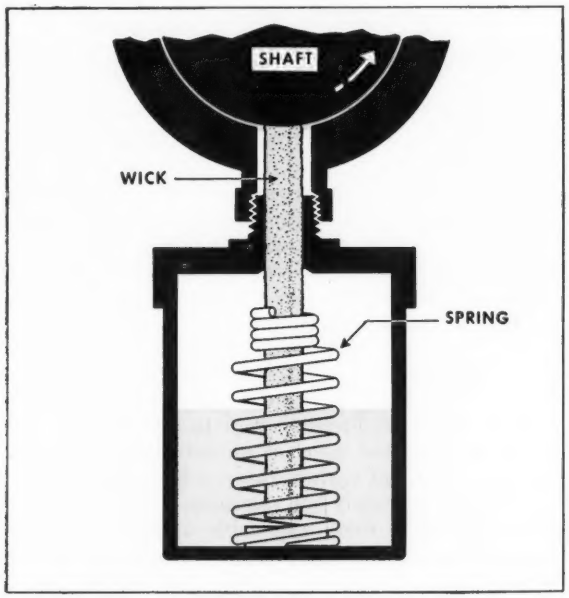

Fig. 15. Under Feed Pad Oiler

the system is expected to function for the service life of the motor without any relubrication.

MECHANICAL POSITIVE FEED LUBRICATOR

There are many types of mechanical lubricators available that can deliver regulated quantities of oil from a drop every five or ten minutes to several drops a second. Lubricant pressures ranging from atmospheric to 5000 psi can be developed. Fig. 17 shows one example of this type of device. A cam or eccentric moves the operating lever which in turn actuates a spring loaded piston. The piston forces the lubricant through the oil outlet valve. The spring returns the piston and, during the return stroke, oil is drawn up through a check valve readying the device for the next delivery. The feed regulating screw may be moved up

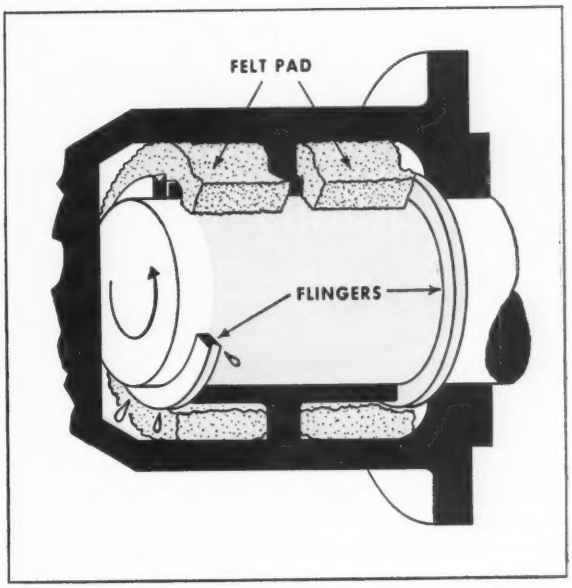

Fig. 16. Saturated Pad Oiler

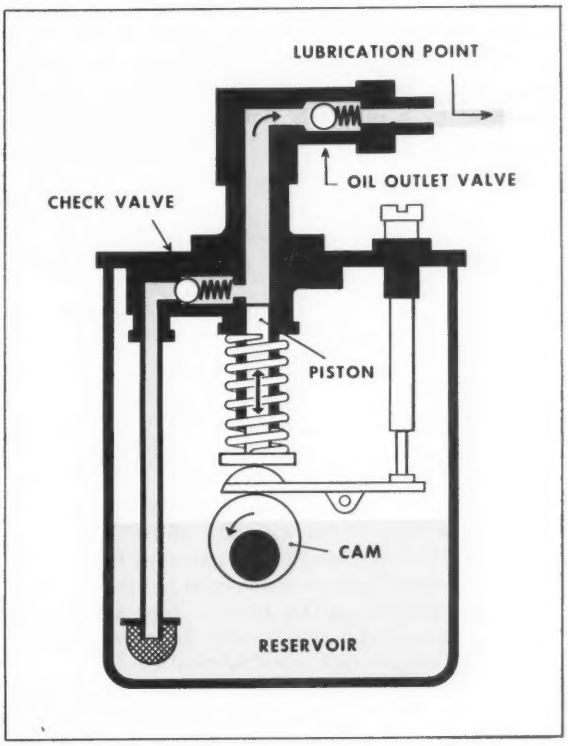

Fig. 17. Mechanical Positive Feed Oiler

and down to hold the operating lever off the cam for a portion of its rotation. In this way, the quantity of lubricant dispensed can be varied.

In many applications, a number of such devices are run from a common reservoir. Generally, there is a separate feed line for each pump.

The lubricators are usually driven off the machine to be lubricated by ratchet connection, oscillating lever, gearing, belts or direct connection.

(To be continued in the next issue)

Frictional Resistance of a Radially-Loaded Journal Bearing with Grease Lubrication

This study was made to determine the effect of the percentage of base in various oils under operating conditions in a radially-loaded sleeve bearing. The principal variable studied was the frictional resistance or torque as it was related to the grease composition at various speeds and radial loads. Results of the investigation indicated that the behavior of the lithium greases studied were generally similar to that of a Bingham plastic. It was also found that the friction torque in a grease-lubricated sleeve bearing could be expressed by a relatively simple equation involving the load and speed.

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INTRODUCTION

The theory of the lubrication of a sleeve bearing utilizing a viscous lubricant, such as oil, has been well established. It is possible to determine frictional torques for a sleeve bearing operating with flood lubrication on the basis of the viscosity of the Newtonian fluid involved. Although conventional lubricating greases are used quite extensively in journal bearings, the theory underlying this type of lubrication is not well developed, and is considerably more complex than that which applies to viscous lubrication.

The following investigation is concerned with the measurement of frictional torque in a radially-loaded plain bearing with various loads, rotational speeds, and grease compositions. This study is thus concerned not only with the viscosity effects of the non-Newtonian lubricant, but also with the effect of radial load as it induces eccentricity of the journal with respect to the bearing and may tend to induce boundary lubrication. Variations arising from the composition of the grease were studied by varying the viscosity of the oil used in the manufacture of the grease, and the percentage of base used to thicken the oil.

One approach to the determination of the viscous properties of greases is that of forcing the fluid through a small cylindrical tube and measuring the flow at various pressures. From these data an *apparent viscosity* is calculated which is an indication of the resistance to flow at various rates of flow. This method is limited to relatively low velocities, and the information obtained is more applicable to flow conditions than to the shearing conditions encountered in bearing operation.

Another conventional approach to the problem is by the use of a rotational viscometer. Shear stresses are determined for various rates of shear. While this method has been used quite extensively, it is not adaptable to the particular case of a radial load applied to one of the rotating cylinders.

Several investigators have studied the behavior of loaded bearings with grease lubrication. Cohn and Oren (5) conducted an experimental investigation of a radially loaded bearing, measuring the distribution of pressure in the lubricant at various angular positions. Lawrence (6) calculated the theoretical pressure distribution in a radial bearing using the apparent viscosity approach. Several analyses have been made of the theoretical aspects of grease lubrication in thrust bearings. These include studies by Slibar and Paslay (9) and by Osterle and Saibel (7).

The present investigation does not involve pressure measurements, nor, is it a theoretical analysis of

the radial bearing. The following results summarize an experimental program which was intended to determine the effects of, radial load, journal speed, and grease composition upon the frictional resistance of a grease lubricated bearing.

NOTATION

c = radial clearance
h = perpendicular distance between shear surfaces
L = axial length
r = variable radius
r_1 = inner radius
r_2 = outer radius
γ = ratio of inner to outer radius
N = rotational speed
ω = angular velocity
V = linear velocity
W = radial load
M_f = friction torque
μ = viscosity
μ_0 = plastic viscosity
τ = shear stress
τ_0 = yield value of shear stress

NON-NEWTONIAN FLOW

Greases generally are non-Newtonian in nature; that is, they are characterized by a variable coefficient of viscosity. This variation may be regarded as a change in structure of the material with the rate at which it is being strained, or with the applied stress. The original structure may be retained at low shear stresses with moderate deformation, and then flow will exist when the shear stress exceeds a critical value. The material is then known as a *plastic solid*, and the critical shear stress is the *yield stress*.

There are three principle types of rheological behavior, as indicated in Fig. 1.

(a) NEWTONIAN, or viscous, in which the shear stress is directly proportional to the velocity and inversely proportional to the distance between the surfaces.

(b) PSEUDOPLASTIC, which has no yield value, but which has a shearing resistance increasing with the velocity as shown.

(c) BINGHAM PLASTIC, which consists of a viscous effect plus an initial yield condition.

Lubricating greases appear to approach most closely the Bingham plastic behavior. Theoretical Bingham plastic flow in the annular space between two concentric cylinders is shown in Fig. 2 for the shear stress condition shown in Fig. 3. It is assumed that the outer cylinder is stationary and the inner cylinder is rotating with the angular velocity, ω. Although the distribution of shear stress $\tau_{r\phi}$ in the annular space between the cylinders can be derived from the differential equations of motion, it is apparent from a consideration of equilibrium conditions that the torque on the inner cylinder must be equal to the product of the shear stress at any radius, the cylindrical shear area, and the radius. Thus the shear stress must vary inversely as the square of the radius, or

$$M_f = \tau_{r\phi}(2\pi r L)r$$

$$\tau_{r\phi} = \frac{M_f}{2\pi r^2 L} \qquad [1]$$

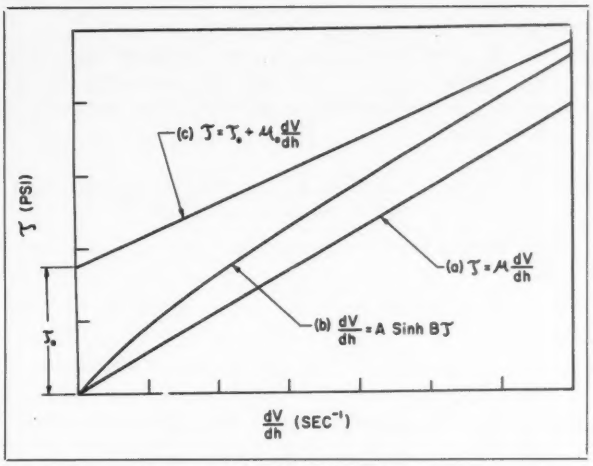

Fig. 1. Characteristic types of rheological behavior.

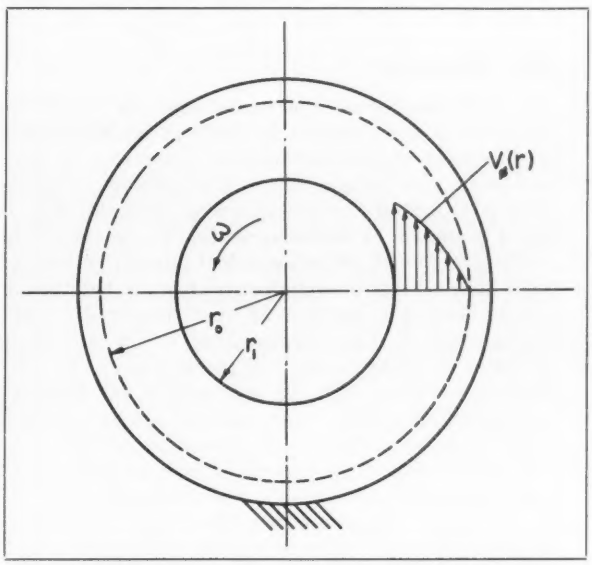

Fig. 2. Theoretical flow pattern of Bingham plastic between two concentric cylinders.

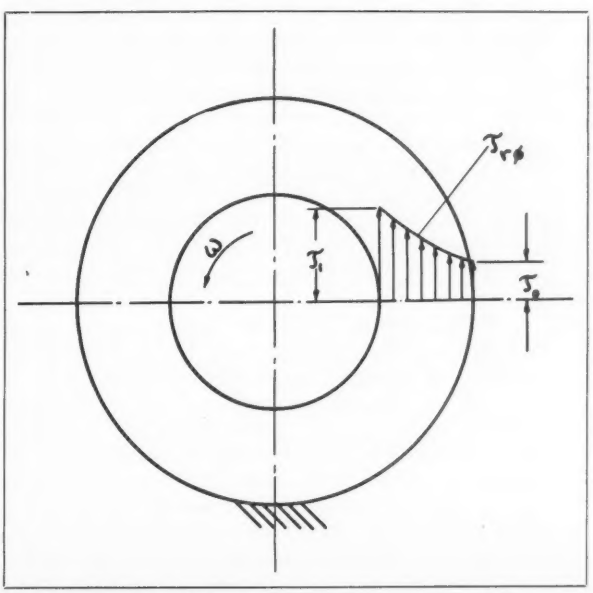

Fig. 3. Shear stress distribution between two concentric cylinders.

By considering the proper boundary conditions, the Reiner-Riwlin equation (8) relating friction torque, the yield stress, τ_0 and the plastic viscosity, μ_0, is obtained.

$$\omega = \frac{M_f}{4\pi L r_2^2 \mu_0}\left(\frac{1}{\gamma^2} - 1\right) + \frac{\tau_0}{\mu_0}\log\gamma \qquad [2a]$$

Or, solving for the torque expression

$$M_f = \frac{4\pi L r_2^2}{\left(\frac{1}{\gamma^2} - 1\right)}\left[\mu_0\omega - \tau_0 \log\gamma\right] \qquad [2b]$$

For small clearances normally encountered in journal bearings, the equation for the two concentric cylinders becomes

$$M_f = 2\pi r_2^2 L\left(\frac{\mu_0\omega r_2}{c} + \tau_0\right) \qquad [3]$$

TEST EQUIPMENT

Experimental data were obtained on a test machine which was designed and built in the Mechanical Engineering Department of the University of Wisconsin, and is shown in Fig. 4. The principle of operation is indicated in the schematic diagram, Fig. 5. Load is applied to the rotating steel journal A by the bearing adapter B, which is pulled upward by the two load links, C. Load is applied by turning handwheels which lower the pulleys, D, and measured by the spring scales, E. Thus the magnitude of the radial load is proportional to the sum of the two scale readings. As the machine is always operated in the balanced position shown, these scale readings are at all times equal. Counterweights, G. on the horizontal load links are used to relieve the journal of all dead loads, making it possible to take data at zero radial load.

Torque is measured by adding a gravity moment to the torque arm, F, sufficient to maintain the horizontal beam exactly level, as indicated by an optical system. The optical system consists of a transit telescope, H, which is mounted horizontally on the upper frame of the machine so it can be viewed by the operator. A mirror is mounted on the movable arm B and another stationary mirror is mounted on the frame. The mirrors are oriented so that a fixed line on the laboratory wall can be viewed through the telescope by means of these mirrors. As the beam H tilts the movable mirror tilts which causes the reference line or image to appear to shift. Because of the large optical arm, this proved to be a sensitive and satisfactory means of determining the level position of the beam.

The test journal is driven from the rear by a constant speed motor through a variable speed mechanical transmission giving speeds of 400 to 3,600 RPM.

The test journal is supported by the machine frame at each side of the test bearing by means of ball-bearings. The test bushing is contained in an adapter which is water-jacketed for temperature control. A copper-constant in thermocouple is located at the bottom of the test bearing, with leads entering a tube in the adapter and with the junction submerged in the lubricant as near to the journal as possible without touching. Lubricant is admitted to the bearing by means of a tube entering the adapter from above. Grooves are provided in the bearing to assist in the distribution of the grease to the bearing surface.

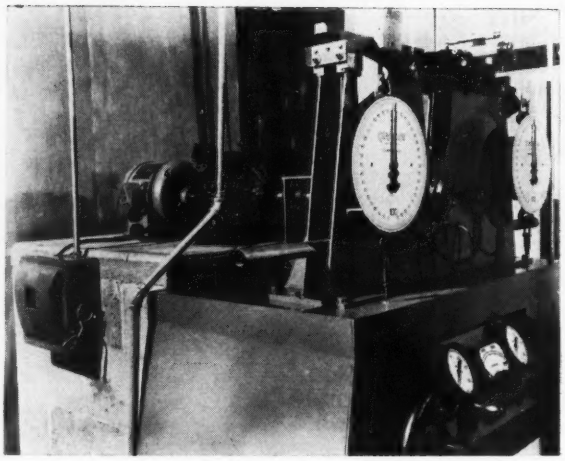

Fig. 4. Experimental bearing testing machine used in the grease tests.

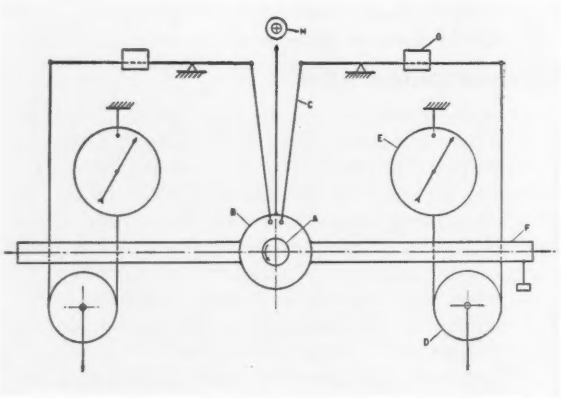

Fig. 5. Schematic diagram of bearing testing machine showing method of loading and measurement.

No seals were used to contain the grease during these tests. The error introduced by the additional friction would have been difficult to determine. Fortunately there was little indication of grease escaping from the test bearing.

TEST CONDITIONS

The test journal is made from heat-treated steel, machined to 1.000″ diameter. The test bearing is a bronze bushing bored to 1.002″, and with a length of 1.00″. Thus the radial clearance is 0.001″, γ is 0.998, and the ratio of length to diameter is unity.

Temperature during the tests indicated in this report was maintained as 90 F., with a maximum variation of ± 2 F.

The grease samples with 4, 8, 12, and 16 per cent soap contain a 60/40 ratio of hydrogenated tallow glycerides and hydrogenated castor oil glycerides as the lithium soap stock. The oil portion of the greases is a blend composed of High V. I. Bright Stock, Intermediate V. I. Bright Stock and 85 viscosity neutral blended to viscosities of 98.3 and 1103 SUS at 100 F.

TEST RESULTS

Typical experimental results are indicated in Fig. 6, in which frictional torque is plotted against journal speed for various radial loads on the bearing. In the range tested these curves are characteristically linear with an intercept at zero speed corresponding to the starting torque. The torque increases with speed from this point. It is also seen that the torque is greater at greater loads for a given speed.

The no-load curve is of particular importance in indicating the grease characteristics. This is the concentric condition corresponding to the classical case indicated in Figs. 2 and 3, and to the relationship given in Eq. [3] for the Bingham Plastic. By substituting values of torque obtained at the no-load condition at two different speeds in Eq. [3] it is possible to solve two simultaneous linear equations for corresponding values of τ_0 and μ_0. Values obtained from this procedure are indicated in Table 1 for a number of grease specimens.

TABLE I

OIL SUS	PER CENT BASE	τ_0 (psi)	μ_0 (LB SEC/IN^2)
98.3	4	0.06	$2.44\ 10^{-6}$
	8	0.13	2.14
	12	0.13	2.44
	16	0.22	3.05
1103	4	0.70	$5.50\ 10^{-6}$
	8	0.70	3.66
	12	1.08	2.44
	16	1.08	2.44

Interpretation of the data from the radially loaded bearing is more difficult. For one thing the journal becomes eccentric with respect to the bearing so the conventional approach to the resistance of the viscous medium cannot be used. For another, the radial load is apt to introduce a certain amount of metal-to-metal contact as the lubrication approaches the boundary condition which will tend to increase the measured torque. Interpretation of the radially loaded bearing results therefore requires the analytical study which follows.

DIMENSIONAL ANALYSIS

A study of the variables or parameters involved in the rotating, radially loaded bearing indicates eight physical quantities, as shown in Table 2.

TABLE 2

	PHYSICAL QUANTITY	SYMBOL	DIMENSIONS
Measured	Frictional Torque	M_f	$M\ L^2\ T^{-2}$
	Angular Velocity	ω	T^{-1}
	Radial Load	W	$M\ L\ T^{-2}$
Geometry	Length of Bearing	L	L
	Diameter of Bearing	D	L
	Radial Clearance	c	L
Calculated	Yield Stress	τ_0	$M\ L^{-1}\ T^{-2}$
	Plastic Viscosity	μ_0	$M\ L^{-1}\ T^{-1}$
	(Temperature = constant)		

Thus there are three fundamental dimensions to express the variables involved. By Buckingham's π theorem there will be eight minus three, or five non-dimensional groups for the eight physical quantities involved in this analysis:

$$\pi_1 = L/D; \quad \pi_2 = c/D; \quad \pi_3 = M_f/Wc; \quad \pi_4 = \tau_0 c^2 W$$

$$\pi_5 = \frac{\mu_0 \omega}{\tau_0}$$

$$\pi_5 = \frac{\mu_0 \omega}{\tau_0}$$

The variables π_1 and π_2 are fixed for the test equipment used. A plot of M_f/Wc versus $\tau_0 c^2/W$ for constant $\mu_0\omega/\tau_0$ is shown in Fig. 7. It can be seen that the curves are linear for each value of $\mu_0\omega/\tau_0$, and that all curves intersect at a point. Thus the general form of the empirical equation becomes

$$\frac{M_f}{Wc} = m\left[\frac{\tau_0 c^2}{W} + C_1\right] + C_2 \qquad [4]$$

where m is the slope of the $\mu_0\omega/\tau_0$ lines and C_1 and C_2 are the intercepts.

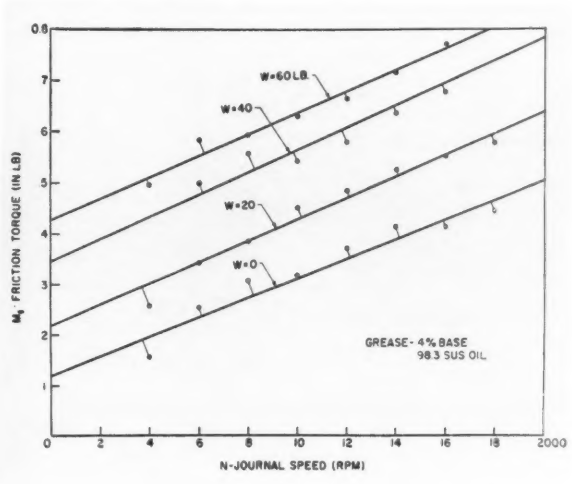

Fig. 6. Typical experimental results at various radial loads.

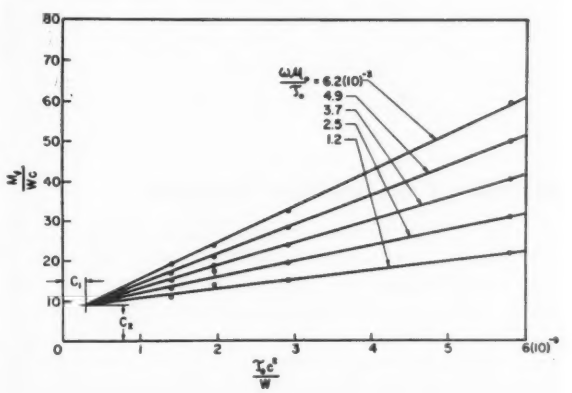

Fig. 7. Plot of non-dimensional variables.

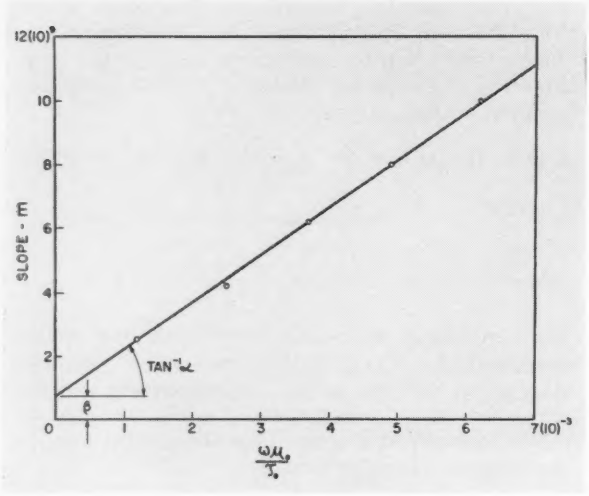

Fig. 8. Plot to determine slope and intercept relations for results shown in Fig. 7.

Now a plot of m versus $\mu_0\omega/\tau_0$ can be made, as shown in Fig. 8, and this in turn is a straight line for a particular grease. Then m may be expressed as follows:

$$m = \alpha\left(\frac{\mu_0\omega}{\tau_0}\right) + \beta \qquad [5]$$

Substituting in Eq. [4]

$$\frac{M_f}{Wc} = \left(\alpha\,\frac{\mu_0\omega}{\tau_0} + \beta\right)\left[\frac{\tau_0 c^2}{W} + C_1\right] + C_2$$

Or

$$M_f = (\alpha\mu_0 c^3)\omega + (\beta\tau_0 c^3) + \left(C_1\,\frac{\alpha\mu_0 c}{\tau_0}\right)\omega W + (\beta C_1 c)W + (C_2 c)W \qquad [6]$$

The expression for torque then may be reduced to

$$M_f = A\omega + BW\omega + CW + D \qquad [7]$$

where

$$A = \alpha\mu_0 c^3 \text{ lb sec in}$$

$$B = C_1\left(\frac{\alpha\mu_0 c}{\tau_0}\right) \text{ sec in}$$

$$C = \beta C_1 c + C_2 c \text{ in}$$

$$D = \beta\tau_0 c^3 \text{ lb in}$$

DISCUSSION OF SUMMARY EQUATION

Eq. [7] indicates that frictional torque in a radially-loaded, grease-lubricated bearing is the sum of four components. The first is due to speed only, the second to speed and load, the third to load only, and the last the resistance of the lubricant to initial motion. Physical interpretations of Eq. [7] are desirable for this relatively simple expression which relates the various parameters. Several interpretations are possible.

At zero radial load, W is zero, and the relation reverts to

$$M_f = A\omega + D \qquad [8]$$

which is similar to (c) of Fig. 1.

$$\tau = \mu_0\left(\frac{dV}{dh}\right) + \tau_0 \qquad [8a]$$

This indicates the Bingham Plastic characteristic of a combined effect of initial yield stress and a velocity stress due to the plastic viscosity. It also can be seen that A contains μ_0 and D contains τ_0.

At zero velocity, ω is zero, and the equation becomes

$$M_f = CW + D \qquad [9]$$

Torque necessary to move the journal from rest under radial load is the sum of a Coulomb frictional resistance and the initial yield stress of the lubricant. If both speed and load are zero, only the initial yield resistance of the lubricant remains. Coulomb friction due to the CW term implies physical contact between the journal and the bearing, and relates C to the coefficient of dry friction. This is further indicated by the absence of μ_0 and τ_0 in the C coefficient.

Another interesting interpretation results from writing Eq. [7] in factor form.

$$M_f = \omega(A + BW) + CW + D \qquad (10)$$

Now the velocity effect on the viscous resistance is seen to be increased by load. This is attributed to the eccentricity of the journal with respect to the center of the bearing, and the corresponding decrease in the film thickness on one side of the journal. The net effect of the eccentricity is to produce a greater friction torque resulting from the plastic viscosity component. Therefore the BW factor represents the increase in the viscous resistance of the lubricant due to the eccentricity produced by the load. The last two terms correspond to those of Eq. [9], which have previously been explained.

A further interpretation results from rewriting the equation in the form

$$M_f = (A\omega + D) + W(B\omega + C) \qquad [11]$$

In this case the first quantity in parenthesis represents the total viscous resistance of the lubricant to motion during rotation of a concentric bearing. The second quantity in parenthesis represents additional viscous resistance caused by eccentric operation of the journal. Thus it is possible to rationalize the various terms of Eq. [7], including the product term, $BW\omega$.

The foregoing equations and dimensional analysis have been based on a given bearing with a given clearance. On the basis of these results a more general equation may be formulated in which both the size of the bearing and the clearance are variables. This equation is of the form:

$$M_f = A\omega + D + W(B\omega + C) = 2\pi\gamma_2{}^2 L\left(\frac{\mu_0\omega\gamma_2}{c} + \tau_0\right) + W(B\omega + C) \qquad [12]$$

where B and C are constants, the dependence of which upon bearing dimensions has not as yet been established.

Experimentally Determined Coefficients

Eq. [7] was determined by means of a dimensional analysis. On the basis of this equation it is possible to determine the constant coefficients for a given grease from test results plotted in the form shown in Fig. 6. The calculations are as follows:

1. A is proportional to the slope of the no-load curve, and equal to the increment in friction torque divided by the corresponding increment in speed $= \Delta M_f/\Delta\omega$
2. B is proportional to the slope at any load, W, minus the slope of the no-load curve. It is calculated from the slope difference by the equation

$$B = \frac{\left(\frac{\Delta M_f}{\Delta\omega}\right)_W - \left(\frac{\Delta M_f}{\Delta\omega}\right)_0}{W}$$

3. C is equal to the difference between the load curve intercept and the no-load curve intercept divided by the corresponding load or

$$C = \frac{(M_f)_W - (M_f)_0}{W} \quad \text{at} \quad N = 0$$

4. D is equal to the intercept of the no-load curve.

Fig. 9 shows the variation of A and μ_0 with the per cent of base. The viscosity at zero per cent base corresponds to that of the oil, and the values shown are obtained by calculation. Addition of the base to the heavy oil (1103 SUS) results in a marked decrease in the plastic viscosity to less than one-tenth of the original value, and a minimum μ_0 reached between 12 and 16 per cent. Only a minor change is indicated for the light oil (98.3 SUS), although in this case also there is an initial decrease in viscosity as base is added to the oil. For both oils the minimum μ_0 is the same, or about 2.2 lb sec/in.^{2}

The effect of grease composition on the initial yield stress is shown in Fig. 10. For both oils an increase in the base content results in an increase in τ_0 and D, with the 1103 SUS oil exhibiting a considerably higher yield stress than the 98.3 SUS oil. The ratio of τ_0 for the heavy oil to τ_0 for the lighter oil is approximately six over the entire range of base content. The curves are drawn to the origin, as τ_0 for an oil, or Newtonian fluid, should be zero.

The coefficient B is determined from the curves shown in Fig. 11 in which the ordinate represents the bearing torque increment at 2,000 RPM corresponding to the increase in slope due to load from curves similar to Fig. 6. These data are dependent upon the slopes determined from the torque-speed diagrams, which in turn are difficult to establish accurately. Results for the 98.3 SUS oil appear to be quite linear; however, the $BW\omega$ values for the 1103 SUS oil show some experimental scatter, with a tendency to droop at high loads. Should these curves be non-linear, the coefficient B could no longer be treated as a constant.

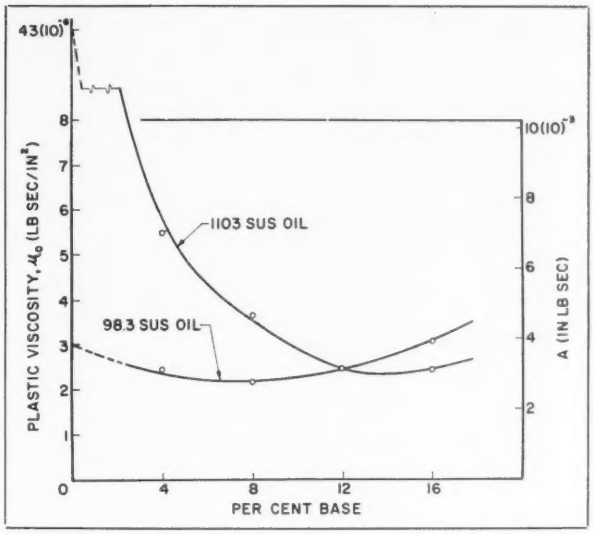

Fig. 9. Variation of plastic viscosity and coefficient *A* with percentage of base.

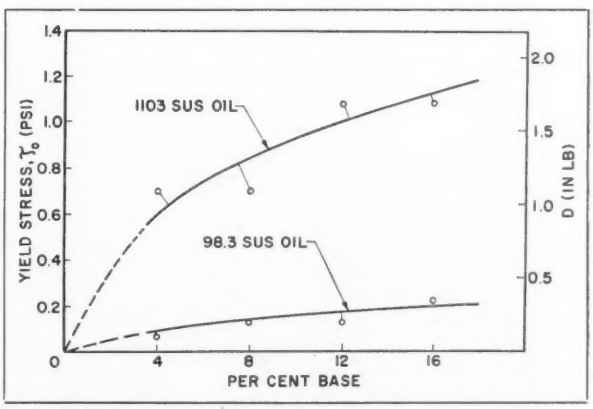

Fig. 10. Variation of yield stress and coefficient *D* with percentage of base.

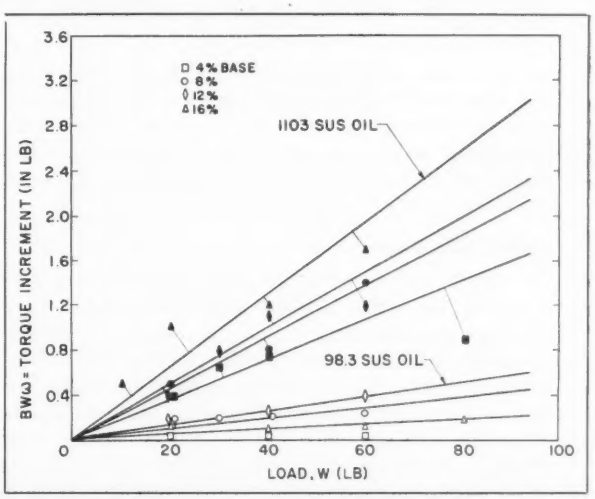

Fig. 11. Torque increment due to combined speed and load effects. Torque values are plotted for 2000 RPM of the journal.

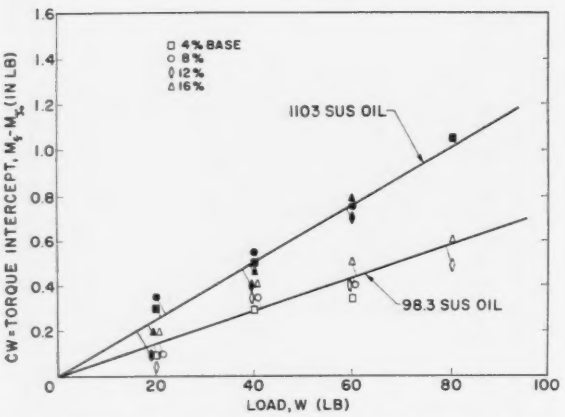

Fig. 12. Torque at zero speed produced by radial load effect.

In Fig. 12 the effect of load on the zero-speed intercept is plotted. As shown, the CW values are proportional to load, are practically independent of the base content, but are dependent upon the oil viscosity.

Values of B and C from Figs. 11 and 12 are summarized in Fig. 13. In general B rises with an increase in base content, although with the lighter oil a decrease is indicated at the 16 per cent base content. As CW curves for various base content reduce to a single straight line, C becomes a horizontal line in Fig. 13.

Interpretation of the unusual behavior of C is difficult. If this coefficient were independent of both base content and oil viscosity, this effect could have been explained as a simple Coulomb friction resulting from partial metal-to-metal contact related to boundary lubrication conditions. Thus, if no lubrication of any kind were present at the microscopic points of contact between the surfaces, Coulomb conditions would prevail. Test results indicate, however, that oil viscosity does effect this component of friction. Therefore, the characteristics of the lubricant have a bearing on the nature of the friction produced, and any theory based on the dry friction concept is apparently invalid.

C is the only coefficient which exhibits an independence, or at least a secondary dependence upon base content. It would appear that the mechanism of the friction torque, CW, is such that the action of the oil and base components are completely independent. All other coefficients are functions of both oil viscosity and base content. Even D, which might be theorized as dependent upon base only which is responsible for the intercept, shows a considerable dependence upon both the oil viscosity and base content.

CONCLUSIONS

As a result of this investigation it is concluded that the frictional torque in a grease-lubricated sleeve bearing increases with increasing speed and with increasing load, as shown in Fig. 6. For the velocity range tested this increase appears to be linear with speed above the zero-speed torque. The behavior below 400 RPM, or 100 FPM surface speed, is not defined. Current research with different equipment but with the same grease samples indicates that the torque drops below the linear curve at low velocities. This departure from the Bingham plastic behavior does not effect the present theory developed for the higher speeds.

From a dimensional analysis the friction torque is found to obey a rather simple law involving four terms, as given in Eq. [7]. This equation involves the following:

(a) A term proportional to the product of journal speed and the plastic viscosity of the lubricant
(b) A term proportional to the product of journal speed and the radial load
(c) A term proportional to the load
(d) A term proportional to the initial shear stress of the lubricant and which is independent of the load and speed.

The equation is empirical in nature and involves experimentally determined coefficients. Further study of the problem may lead to a more theoretical approach to the evaluation of these coefficients.

As indicated in Eq. [12], the no-load coefficients A and D may be calculated for a given bearing if the plastic viscosity μ_0 and the yield stress τ_0 are determined for a particular grease. Variation of the no-load

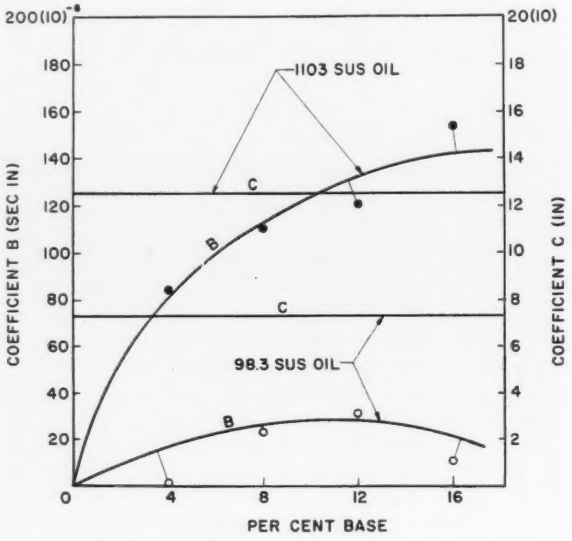

Fig. 13. Variation of coefficients B and C with percentage of base.

factors with grease composition is shown in Figs. 9 and 10. In general increasing the base content decreases μ_0, but increases τ_0.

The load-related coefficients are shown in Fig. 13. B generally increases with base content. C seems to be independent of base content, but is greater for the higher viscosity oil.

This investigation indicates certain phenomena which occur in a grease-lubricated bearing. Although only one bearing and a limited number of grease types were used, characteristic behavior patterns have been established, as well as methods for the interpretation of torque-speed test data at various loads. Therefore, although no broad conclusions can be drawn from the results obtained, a rational approach to the study of the frictional behavior of a Bingham plastic type lubricant in a bearing has been established.

(Continued on page 290)

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Lubrication Abstracts

Edited by W. E. Campbell

Selected literature compiled by members of the Technical Committees and Industry Councils of the Society.

R. O. Lee, "Lubrication of Titanium," Wright Air Dev. Center Tech. Rept. No. 57-61, (Clevite Res. Centre) *Scientific Lubrication* (London), v. 11, no. 1, 1959, 30.

An investigation on the role of oxide films on titanium, and on the wear resistance of best available surface treatments in the presence of various lubricants is described. Studies on the stick-slip machine show that the oxide layer is easily penetrated, while the friction coefficient remains practically constant. Moisture is also important and generally acts as a lubricant depending on the previous surface treatment. Halocarbon 11-14 is an effective lubricant on both untreated and treated titanium surfaces, as confirmed on the Shell Four-Ball Wear Tester. Nitriding improves wear properties and lowers the coefficient of friction in nearly all lubricants, and carburizing also improves the wear and frictional properties with most lubricants. Polypropylene glycol 1025 and Halocarbon 11-14 have practically identical frictional and wear properties for any of the nitrided metals, but the latter is better for carburized Ti 6A1 4V. Bronze sliding against titanium improves the frictional and wear properties of Ti 7 5A, but the use of this material partially defeats the objectives for using titanium. The lowest wear rates for any titanium specimen in the best lubricant are still about twice as large as those for steel. (*Abstractor: R. McKay*)

Leo Krasnor, "A Method of Reclaiming Cutting Fluid (Wash Waste) by Means of Homogenization," PB 140 741. SA-TR16-1056. Nov. 22, 1958, U. S. Government Research Reports, v. 32, no. 2, 1959, 218.

An investigation is described to determine the feasibility of reclaiming cutting fluids (wash waste) for use as an emulsifiable cutting fluid by means of a homogenization process. Limited tests indicate that cutting fluid reclaimed by this process is equal to commercially obtainable emulsifiable cutting fluids. The test procedure is described, and results discussed. (*Abstractor: R. McKay*)

G. J. O'Donnell (Shell Dev. Co.), "Viscoelasticity in Lubrication," *Mech. Eng.*, v. 81, No. 2, 1959, p. 63-5.

A review of the basic concepts of viscoelasticity is presented. Possible applications of these concepts to lubrication are discussed, and it is shown that the elastic properties of a lubricant could be of importance in high speed bearings and gears. A need for a better understanding of viscoelasticity and under what conditions a fluid displays this property is stressed. It is suggested that such information might influence the design of high speed machines and their lubricants. (*Abstractor: E. O. Forster*)

Staff Writer, "Hot Machining Gets Trial," *Steel*, v. 145, no. 18, 1959, 78-80.

Increase in part temperature reduces the abrading force on the tool. The studies show that tool life does not increase proportionately to temperature but an optimum temperature is reached. Lubricants are not recommended for elevated temperature machining. Limitation of hot machining procedures are indicated. (*Abstractor: R. McKay*)

J. W. Javin (Atlantic Refining Co.), "Designing Oils for a 2-Stroke Engine," SAE Paper no. 65T for Meeting June 14-19, 1959, 18 pp.

Results of laboratory tests utilizing a 2-stroke engine show that a properly compounded oil will perform better than the best non-additive oil. However, base oils and additive components must be carefully selected to avoid undesirable side effects. (*Abstractor: M. I. Smith*)

Grover G. Collins, "Borax in the Wire Drawing Industry," *Wire & Wire Products*, v. 34, no. 8, 1959, 968.

Borax coatings for drawing steel rod have been growing in popularity, not as a substitute for other materials, but for inherent advantages in neutralizing residual acid, corrosion protection, to carry lubricant, and to keep out dust. Added benefits frequently reported are longer die life and lower lubricant consumption. Preparation of the rod for drawing and the nature of the borax coating are discussed. Ten other benefits are listed. (*Abstractor: E. E. Emmerich*)

Earl A. Bowers, Jr. (Vice President Standard Industrial Compounds Co.), "Advanced Lubricants and Pressure Dies for Better Wire Drawing," *Wire & Wire Products*, v. 34, no. 8, 1959, 953.

Applications of metallic soaps with extreme pressure additives to Pressure Die high speed wire drawing are described. Specific applications show a 2-½ X improvement in tonnage per shift and 2 X improvement in die life. (*Abstractor: E. W. Emmerich*)

Staff writer, "Automatic Chip Handling, Oil Recovery Pay Off," *Steel*, v. 146, no. 3, 1960, 90-91.

A continuous metal chip handling and cutting oil recovery system is described. Specific benefits at the bearing plant of one company include premium of $3. to $4. per ton for oil from chips of uniform size, reduction in cutting oil consumption by 50 percent, improvement in plant housekeeping, more efficient use of rail car capacity, reduction in demurrage by chip storage facilities and release of manpower normally required for cleanup. The recovered cutting oil is sterilized and solid contaminants removed before reuse. (*Abstractor: R. McKay*)

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Patent Abstracts

Compiled by Ann Burchick
Aluminum Co. of America

Blended Lithium Calcium Base Grease, Patent #2,908,645 (A. J. Morway, assignor to Esso Research & Engineering Co.) A blended grease composition comprising a blend of two component greases, one component being a grease thickened with a calcium mixed salt complex of low and intermediate molecular weight mono-carboxylic acids, wherein the mol ratio of low to intermediate weight acid is about 2:1 to 40:1, the other component being a lithium base grease thickened with the lithium soap of a high molecular weight fatty acid, said blend consisting essentially of from 40 to 80% by weight of the first component and 20 to 60% by weight of the second component.

Lubricating Oil Composition, Patent #2,916,455 (A. F. Millikan and G. W. Crosby, assignors to The Pure Oil Co.) A lubricant consisting essentially of mineral lubricating oil and a small amount, sufficient to enhance the load-carrying and wear-resistant properties of the oil.

Anti-Rust Emulsion Resistant Mineral Oil Composition, Patent #2,908,649 (E. P. Cunningham and D. W. Dinsmore, assignors to Monsanto Chemical Co.) A rust inhibiting composition comprising a major amount of a mineral oil fraction containing (a) between about 0.001% and about 50% by weight based on the mineral oil fraction of the reaction product obtained by reacting an aliphatic monocarboxylic acid containing from 10 to 30 carbon atoms with a polyalkylenepolyamine, the said reaction product dissolved in the said mineral oil fraction providing a solution characterized by being normally susceptible to the formation of oil-in-water emulsions in the presence of water, and (b) between about 0.001% and about 15% by weight based on the mineral oil fraction of a dimeric acid produced by the condensation of unsaturated aliphatic monocarboxylic acids having between about 16 and about 18 carbon atoms per molecule, and (c) about 5% to about 20% by weight based on the dimeric acid content of an acid ester of phosphorus.

Method of Preparing Mixed-Salt Containing Lubricants, Patent #2,909,485 (A. Beerbower and W. H. Gay, assignors to Esso Research & Engineering Co.) A method of forming a fluid lubricant comprising lubricating oil and about 8 to 16 weight percent of a mixed-salt material comprising alkaline earth metal salt of a C_7 to C_{30} fatty acid and alkaline earth metal salt of a C_2 to C_3 fatty acid, in a molar ratio of about 5 to 40 moles of said C_2 to C_3 fatty acid salt per mole of said C_7 to C_{30} fatty acid salt, which comprises forming a slurry of a portion of the lubricating oil, alkaline earth metal base, and a material selected from the group consisting of C_7 to C_{30} fatty acid and alkaline earth metal salt of C_7 to C_{30} fatty acid, mixing a C_2 to C_3 fatty acid anhydride into said slurry, the proportion of lubricating oil and other ingredients being such that a finishing temperature of about 300 to 350 F. is obtained by the heat of reaction, adding the remainder of said oil and then cooling to form said lubricant.

Stabilization of Petroleum Waxes, Patent #2,910,373 (J. A. Chenicek, assignor, by mesne assignments, to Universal Oil Products Co.) Petroleum wax subject to oxidative deterioration containing, as an inhibitor against said deterioration, a stabilizing concentration of a beta-alkylthioamide having at least two carbon atoms in straight chain arrangement with the carbon atom of a carbonyl group, a sulfur atom on the carbon atom beta to the carbonyl group and a nitrogen atom attached to the carbon atom of the carbonyl group.

Stabilization of Lubricants, Patent #2,910,437 (Ted Symon, assignor, by mesne assignments, to Universal Oil Products Co.) A lubricant normally subject to oxidative deterioration containing as an inhibitor against said deterioration, a stabilizing concentration of 2, 4'-diaminodiphenyl ether.

Preparation of an Extreme Pressure Additive and Gear Oil Containing Same, Patent #2,910,438 (P. R. Chapman and A. A. Manteuffel, assignors to The Pure Oil Co.) The process of preparing an extreme pressure additive which comprises sulfurizing fatty oil with sulfur at a temperature of 315 to 360 F. to a sulfur concentration of about 5% to 10% by weight of the fatty oil for a period of 2.5 to 6 hours until it produces a tan color upon immersing in the sulfurized oil at a temperature of 300 F. a copper strip for 1 minute, stopping the reaction at this stage and thereafter phosphorizing said sulfurized fatty oil at a temperature of about 220 to 235 F. to a concentration of bound phosphorus in the fatty oil of at least about 0.40% by weight of the sulfurized-phosphorized fatty oil until the product gives a tan colored copper strip upon immersion in the product for 1 minute at 300 F.

Adhesive Lubricants, Patent #2,910,440 (G. R. Cook and W. W. Cortiss, assignors to The Pure Oil Co.) A petroleum lubricating composition characterized by its adhesiveness to metal surfaces, comprising a major proportion of a viscous residual oil of the class consisting of residues from the distillation of lubricating oils and solvent extracts obtained in the solvent refining of lubricating oils and 1–15% by weight of the dark polymerized methyl esters of rosin obtained as the residue from the vacuum distillation of the dark methyl ester of rosin, said polymerized methyl ester of rosin having a melting point of about 212 F., a molecular weight of about 760, and an acid number of about 15.

Rust Preventive Compositions, Patent #2,911,309 (H. W. Rudel and W. Seitz, assignors to Esso Research and Engineering Co.) A rust inhibiting water displacing composition consisting essentially of a major proportion of a mineral oil, an oil soluble rust preventive in amounts of about 0.5 to 30 parts by weight of total composition selected from the group consisting of C_{12} to C_{22} fatty acid partial esters of aliphatic polyhydric alcohols having about 3 to

(Continued on page 286)

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PATENT ABSTRACTS

(Continued from page 284)

12 carbon atoms, alkali and alkaline earth metal salts of petroleum sulphonic acids, and alkyl aryl sulphonic acids having average molecular weights of about 350 to 520, and a water displacing agent in amounts of about 0.1 to 10 parts by weight of total composition.

Mineral Lubricating Oil Composition, Patent #2,911,367 (R. E. Baus and E. E. Fisher and P. R. Pendell, assignors to Gulf Oil Corp.) An improved lubricating composition comprising a major proportion of a mineral lubricating oil and minor proportions consisting of about 1 to about 5 percent by weight of an alkali metal salt of an oil-soluble sulfonic acid; about 0.1 to about 1.5 percent by weight of a metal alkyl thiophosphate, said metal being a metal of group II of the periodic system and said alkyl thiophosphate containing at least one alkyl group containing between 3 and 12 carbon atoms; about 0.1 to about 5.0 percent by weight of a partial ester of a fatty acid containing between 12 and 24 carbon atoms and a polyol containing from 3 to 6 carbon atoms and from 3 to 6 hydroxyl radicals per molecule; and about 1 to about 3 percent by weight of an ethylene glycol C_8 branched-chain alkyl ether selected from the group consisting of ethylene glycol ethylbutyl ether, diethylene glycol ethylbutyl ether, ethylene glycol methylpentyl ether and diethylene glycol methylpentyl ether.

Low Temperature Stability of Synthetic Lubricants, Patent #2,911,368 (B. T. Fowler, M. F. Hoare and H. G. Krischai, assignors to Esso Research and Engineering Co.) A process for improving the low temperature viscosity of a synthetic lubricating composition, said composition consisting essentially of a blend having a viscosity at 210 F. in the range of 1 to 20 cs. of a complex ester prepared from nonyl alcohol, sebaic acid, and a polyethylene glycol of a molecular weight of about 200, by forming a half ester of the polyglycol and the acid in the first stage, and esterifying the acid product so formed with the monohydric alcohol in a second stage and a di-ester consisting essentially of di-nonyl sebacate, said process comprising adding to said blend in the range of 0.1 to 2.0 weight percent of a guanidine salt of an oxy acid, heating said mixture above 100 C. and filtering said mixture.

High Temperature Grease Containing Free Metal Base and Silicone Polymer Oil, Patent #2,911,369 (S. J. Zajac and R. A. Swenson, assignors to Standard Oil Co.) A lubricating grease composition comprising a major proportion of a lubricating oil selected from the group consisting of a hydrocarbon oil, a diester of a dicarboxylic acid and an aliphatic alcohol, and a high molecular weight polyalkylene glycol from about 0.5 to about 10% of a normally liquid silicone polymer oil in the lubricating oil viscosity range, from about 1% to about 20% of a metal soap of a high molecular weight fatty acid selected from the group consisting of an alkali metal soap, an alkaline earth soap and mixtures thereof, and from about 3% to about 500%, based on the metal soap content of said composition, of a free basic compound selected from the group consisting of an alkali metal hydroxide, an alkali metal oxide, an alkaline earth hydroxide and an alkaline earth oxide.

Lubricants, Patent #2,912,381 (E. G. De Witt, assignor to Ethyl Corp.) An improved lubricating composition comprising mineral oil and from about 0.05 to about 25 percent by weight of a tri-(β-halopropyl)-thionophosphate containing from 1 to 4 sulfur atoms per molecule, the halogen atoms of said thionophosphate each having an atomic weight of at least 35.

Compression Refrigeration Working Fluid, Patent #2,912,383 (W. J. Huth, assignor to Sun Oil Co.) Compression refrigeration working fluid consisting essentially of a halogenated hydrocarbon refrigerant, a mineral oil compression refrigeration lubricant, and from 5 to 20 percent by volume, based on said lubricant, of a soluble polymeric styrene, having average molecular weight in the range of 200 to 100,000.

Glycol Extract and Water-Based Hydraulic Fluid Containing the Same, Patent #2,912,384 (E. R. Vierk and T. J. Smollett, assignors to Sinclair Refining Co.) A fluid glycol extract composition consisting essentially of about 1 to 3 parts of a petroleum sodium sulfonate, about 0.7 to 2 parts of petroleum oil of lubricating viscosity and about 3 to 5 parts of ethylene glycol, obtained by extracting about .8 to 2.5 parts by weight of a petroleum sodium-sulfonate-petroleum oil mixture with about one part by weight of glycol, said mixture consisting essentially of about 0.3 to 1.0 part by weight of sulfonate and about 0.5 to 1.5 parts by weight of petroleum oil of lubricating viscosity.

Textile Lubricants, Patent #2,913,407 (K. F. Schiermeier, assignor to Shell Development Co.) A textile lubricating composition consisting essentially of a major amount of mineral oil containing from about 0.25% to about 3% each of (1) an oil-soluble alkali metal petroleum sulfonate, (2) a partial ester of a simple alkane polyol and a fatty acid having from 12 to 18 carbon atoms, (3) a mixture of (a) an ester of a monohydric aliphatic alcohol having from 2 to 8 carbon atoms and a fatty acid having from 1 to 5 carbon atoms and (b) a monohydric aliphatic alcohol having from 2 to 8 carbon atoms portion (a) being 60-90% and portion (b) being 10-30% of mixture (3) and (4) an alkyl phenol.

Silica-Thickened Grease Containing Carbamate Sole as Dispersant, Patent #2,913,409 (N. L. Remes, T. W. Martinek and E. T. Fronczak, assignors to The Pure Oil Co.) A lubricating grease comprising a major portion of an oleaginous lubricating liquid having incorporated therein sufficient finely-divided silica to produce a gel-like grease structure and a carbamate.

Soluble Oil, Patent #2,913,410 (E. E. Fisher, assignor to Gulf Oil Corp.) A soluble oil composition consisting essentially of 80 to 95 per cent mineral lubricating oil, from 3 to 7 per cent potassium soap of resin acids, from 4 to 7 per cent sodium petroleum sulfonate with an average molecular weight of 425 to 430 and a coupling agent in an amount sufficient to produce a readily emulsifiable soluble oil.

Metal Working Lubricant, Patent #2,913,411 (K. F. Schiermeier, assignor to Shell Development Co.) A transparent water soluble concentrate consisting essentially of a mineral oil-in-water solution, wherein the mineral oil has a viscosity in the range of from about 40 to about 200 SUS at 100F., the oil is 10-30% by weight of the solution and the water is 50-60% of the solution and the concentrate contains from about 5% to about 25% of an oil-soluble alkali metal petroleum sulfonate, from about 4% to about 10% of an alkali metal compound selected from the group consisting of alkali metal ricinoleate and alkali metal salt of castor oil fatty acids and from about 0.1% to about 2% of an alkali metal carbonate.

Lubricating Oil Compositions, Patent #2,913,412 (R. J. Moore, E. K. Ryder, Jr. and R. C. Jones, assignors to Shell Development Co.) A lubricating oil composition, beneficial for reducing the octane requirement and for keeping engines clean which operate on a knock-inhibited fuel, consisting essentially of a major amount of mineral lubricating oil containing from 0.1% to 10% of a C_{6-22} alkyl naphthenodiaromatic hydrocarbon compound selected from the group consisting of an enriched Bright Stock fraction containing about 15% to 35% of an alkyl naphthenonaphthalene, C_{16}-C_{22} alkyl acenaphthene and C_{16}-C_{22} alkyl fluorene and from 0.1% to 5% of an alkaline earth metal alkyl phenate.

(Continued on page 288)

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PATENT ABSTRACTS

(*Continued from page 286*)

Antirust Composition, Patent #2,914,478 (L. L. Neff, assignor to Union Oil Co. of California) A composition for protecting ferrous metal surfaces against rusting consisting essentially of a hydrocarbon oil fraction containing between about 0.1% and about 4% by weight of a triester of thiophosphoric acid.

Upper Cylinder Lubricant and Tune-Up Solvent Composition, Patent #2,914,479 (T. B. Tom and A. E. Brehm, assignors to Standard Oil Co.) An upper cylinder lubricant and tune-up solvent composition capable of introduction into the carburetor of an internal combustion engine while operating, boiling essentially above the boiling range of gasoline, and consisting essentially of about 50 to 90 volume percent of a light aromatic oil extract obtained from the selective solvent extraction of an SAE-5W to 10W petroleum lubricating oil and about 10 to about 50 volume percent of ethylene glycol monoethyl ether.

Paraffin Wax Compositions Having Improved Flexibility, Patent #2,915,447 (K. G. Arabian, assignor to Shell Development Co.) A wax composition comprising, 70-95% by weight of a continuous series of normal paraffin hydrocarbons having from about 18 to about 31 carbon atoms per molecule, the individual C_{18-21} hydrocarbons being present in an amount less than about 5% by weight each and 5-30% of normal C_{19-21} paraffin hydrocarbons, said composition having a greater flexibility at a temperature between 23.0 C and 32.1 C. than that of the continuous series of hydrocarbons in the absence of the added C_{19-21} paraffin hydrocarbons.

Two-Stage Hydrogenation Process for Producing Oxidation Resistant Lubricants, Patent #2,915,452 (J. Van Dyck Fear, assignor to Sun Oil Co.) Process for producing stable petroleum lubricating oil which comprises: contacting petroleum lubricating oil with hydrogen and a metallic hydrogenation catalyst at a temperature within the approximate range from 450 to 750 F., pressure within the approximate range from 150 to 3000 p.s.i.g., and liquid hourly space velocity within the approximate range from 0.5 to 10; and subsequently contacting said oil with hydrogen and a metallic hydrogenation catalyst at a temperature within the approximate range from 650 to 850 F., pressure within the approximate range from 100 to 2500 p.s.i.g. and liquid hourly space velocity within the approximate range from 0.25 to 5; the severity of the second-named contacting being greater than that of the first-named contacting.

Compounded Lubricant Compositions and Composite Addition Agents Therefor, Patent #2,915,464 (T. L. Cantrell and J. G. Peters, assignors to Gulf Oil Corp.) A lubricant composition comprising a major amount of a hydrocarbon lubricating oil and containing a small amount, sufficient to improve the load carrying properties of the oil, of a combination of (a) a sulfurized monoester addition product of sulfur and an unsaturated ester of an aliphatic monohydric alcohol that contains 14 to 20 carbon atoms and not more than one ethylenic linkage per molecule and an aliphatic monocarboxylic acid that contains 10 to 20 carbon atoms and not more than one ethylenic linkage per molecule, (b) a salt of a cycloaliphatic monoamine that contains 5 to 12 carbon atoms per molecule and a dialkyl o-phosphoric acid that has one alkyl substituent containing 8 to 12 carbon atoms and another containing 5 to 8 carbon atoms, and (c) a salt of an aliphatic monoamine that contains 8 to 18 carbon atoms per molecule and an N-alkylamidophthalic acid whose alkyl substituent contains 8 to 18 carbon atoms, said small amount comprising at least about 0.003 percent by weight of the composition of said sulfurized monoester, at least about 0.0125 percent by weight of the composition of said salt of said cycloaliphatic monoamine, and at least about 0.005 percent by weight of the composition of said salt of said aliphatic monoamine.

Improved Mineral Lubricating Oil Composition, Patent #2,915,466 (S. K. Talley, R. A. Coil and J. T. Koot, assignors to Shell Development Co.) A lubricating oil composition consisting essentially of a major amount of a mineral lubricating oil and containing from about 0.1% to about 6% by weight each of oil-soluble calcium petroleum sulfonate and oil-soluble calcium salt of sulfur-free octylphenol-formaldehyde condensation product and from about 0.01% to about 0.2% by weight of an oil-soluble alkylamine selected from the group consisting of primary and secondary dodecylamine, tetra decylamine, hexadecylamine and octadecylamine.

Method of Preparing an Anhydrous Calcium Grease, Patent #2,915,467 (M. M. McCormick, assignor to Sinclair Refining Co.) In the preparation of an anhydrous calcium soap grease wherein the soap is formed from hydroxy fatty components and the grease dehydrated at a temperature not exceeding about 260 F. to a water content at least as low as 0.3 weight percent, the step of heating the dehydrated grease at a temperature which is higher than the dehydration temperature and is about 5 to 20 F. below the dropping point of the grease for a period of about 15 minutes to 3 hours and sufficient to stabilize the essential structure of the grease.

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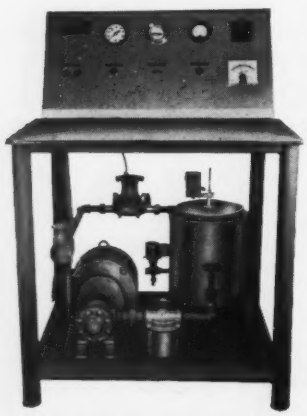

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PATENT ABSTRACTS

(*Continued from page 288*)

Lubricating Oil Compositions, Patent #2,915,471 (L. E. Lorensen, assignor to Shell Development Co.) A mineral lubricating oil containing from about 0.1% to about 10% of an acrylic acid ester polymeric thickener, said thickener having molecular weights within the range from 1×10^4 to 1×10^6 and from about 0.1% to about 5% of an oil-soluble fluorine containing organic compound selected from the group consisting of fluorine containing aromatic hydrocarbon, fluorine containing cyclic ether and fluorine containing alkylamine.

Manufacture of Micro-Crystalline Wax Impregnated Electric Cables, Patent #2,914,429 (A. King, assignor to British Insulated Callender's Cables Ltd.) In the manufacture of a fully impregnated non-draining paper insulated cable, the method which comprises impregnating the paper of the cable uith an impregnating compound which is a normally plastic solid and which comprises as an essential ingredient micro-crystalline petroleum wax having a melting point ranging between about 85C. and 90C. and needle penetration values ranging from about 5 and 6 at 25C. to between 35 and 50 at 70C., the proportion of said micro-crystalline petroleum wax in the normally plastic solid being at least about 48% by weight, at least part of said micro-crystalline petroleum wax having a melting point of about 88C. and needle penetration values of about 5 at 25C. and about 35 at 70C.

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FRICTIONAL RESISTANCE OF A RADIALLY-LOADED JOURNAL BEARING WITH GREASE LUBRICATION

(*Continued from page 280*)

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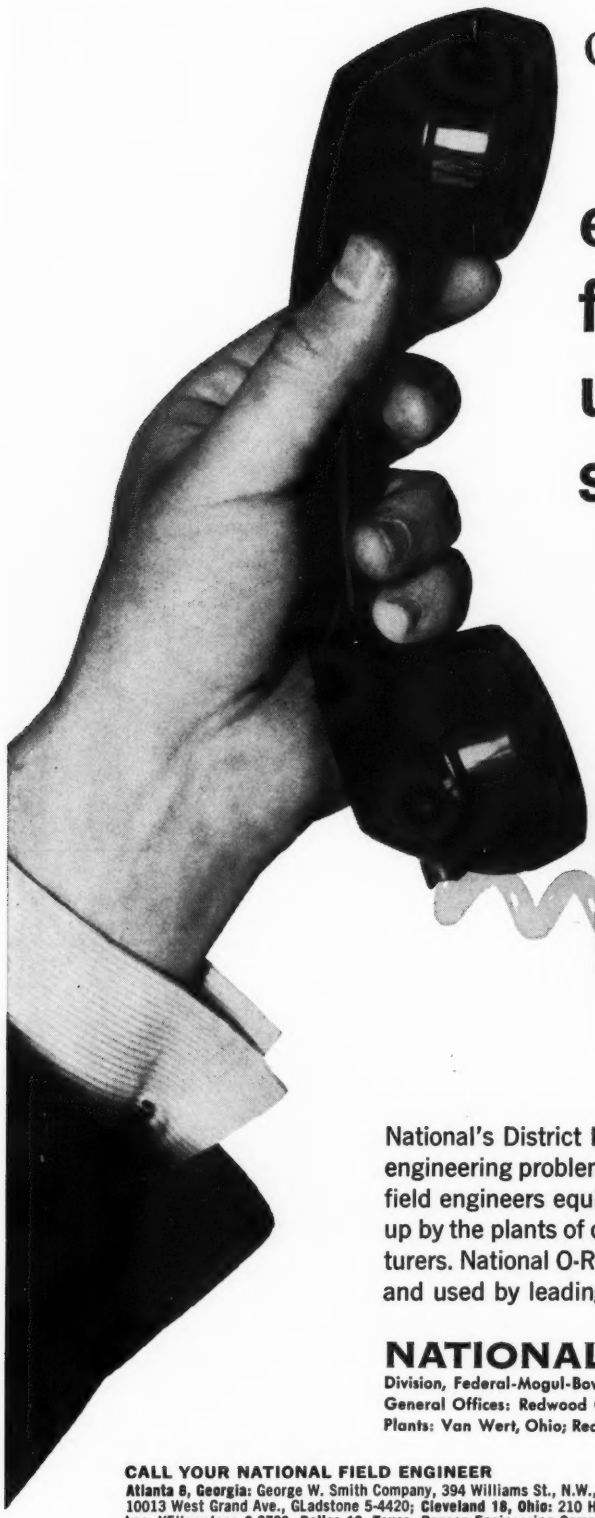
ACKNOWLEDGMENTS

This experimental work was preceded by several graduate research thesis projects in the Department of Mechanical Engineering at the University of Wisconsin which contributed to the development of the test equipment. The graduate students were Robert E. Doyle, Peter W. Kelly, and Ronald O. Anderson, and their help is acknowledged. Assistance was obtained from Professor R. B. Bird of the Department of Chemical Engineering in developing the theory relating to rheological flow. Finally, credit is due the Pure Oil Research Laboratory, Crystal Lake, Illinois, for the preparation of all the grease samples used in these tests.



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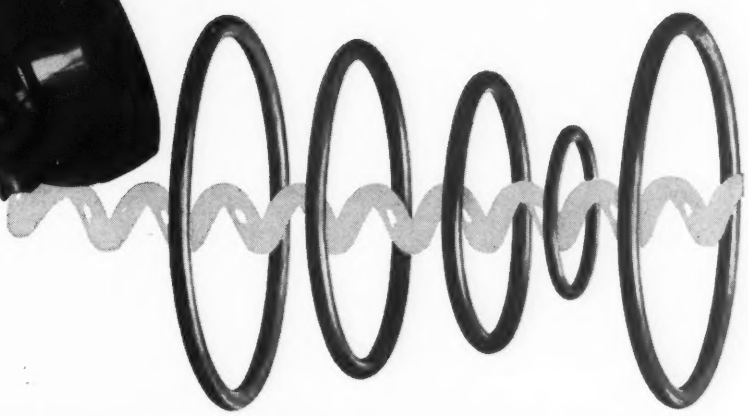

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SECTION NEWS

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which management can justify a lubrication engineer with greater savings and improved operations. . . . A. R. Eckber, Eastman Kodak, was the guest speaker on the subject, "Management's Evaluation of an Industrial Lubrication Program." . . . **New York**—The May meeting featured G. R. Arbocus, E. F. Houghton and Co., whose topic was "Lubrication of High Temperature Conditions." His discussion covered available fluids and greases and the practical limitation of these products and methods of application. While this was the last meeting of the 1959–60 season, the Section members held their 2nd Annual Outing for "loafers and golfers."

L. E. Hoyer, Chairman of the New York Section, is shown introducing Dr. A. B. Wilder (right upon his visit to the New York Section meeting while he was ASLE President.

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Hermes Electronics Co. of Cambridge, Mass. has appointed Eastern Associates Inc. as sales representatives for its crystal filter line. Hermes offers crystal filters, crystal discriminators, voltage control oscillators, and associated systems. Ralph Blair and Harry Rutstein will cover Maryland, Washington, D. C., and Virginia from their Baltimore office located at 808 Ingleside Avenue, Baltimore 28, Maryland. Harold Sheeder, Philip Goldstein and Julian Silverman will cover southern New Jersey, eastern Pennsylvania and Delaware from their office located at 820 Homestead Road, Jenkintown, Pennsylvania.

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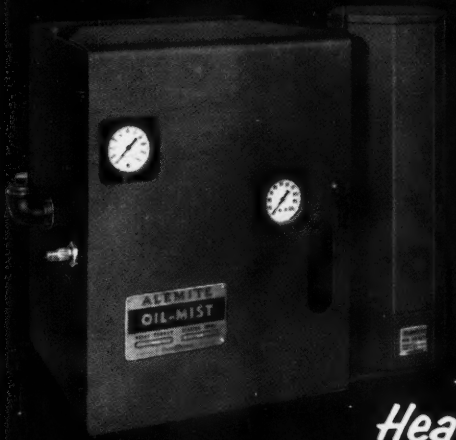

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